EA-87-02

Ontario

ENVIRONMENTAL ASSESSMENT BOARD

VOLUME: 282

DATE: Monday, January 28, 1991

BEFORE:

A. KOVEN CHAIRMAN

E. MARTEL MEMBER

FOR HEARING UPDATES CALL (COLLECT CALLS ACCEPTED) (416)963-1249

FARR & ASSOCIATES REPORTING INC.

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2300 Yonge St., Suite 709, Toronto, Canada M4P 1E4

EA-87-02

HEARING ON THE PROPOSAL BY THE MINISTRY OF NATURAL RESOURCES FOR A CLASS ENVIRONMENTAL ASSESSMENT FOR TIMBER MANAGEMENT ON CROWN LANDS IN ONTARIO

IN THE MATTER of the Environmental Assessment Act, R.S.O. 1980, c.140;

- and -

IN THE MATTER of the Class Environmental Assessment for Timber Management on Crown Lands in Ontario;

- and -

IN THE MATTER OF a Notice by the Honourable Jim Bradley, Minister of the Environment, requiring the Environmental Assessment Board to hold a hearing with respect to the Class Environmental Assessment (NO. NR-AA-30) of an undertaking by the Ministry of Natural Resources for the activity of Timber Management on Crown Lands in Ontario.

Hearing held at the offices of the Ontario Highway Transport Board, Britannica Building, 151 Bloor Street West, 10th Floor, Toronto, Ontario, on Monday, January 28th, 1991, commencing at 10:30 a.m.

VOLUME 282

BEFORE:

MRS. ANNE KOVEN	Chairman
MR. ELIE MARTEL	Member

Farr & Associates Reporting, Inc.

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MR. P.D. McCUTCHEON	GEORGE NIXON
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---Upon commencing at 10:30 a.m.

MADAM CHAIR: Good morning. Please be seated.

Good morning.

THE WITNESS: Good morning.

MADAM CHAIR: Mr. Lindgren?

MR. LINDGREN: Good morning, Madam Chair and Mr. Martel.

MADAM CHAIR: Before we get started, Mr. Lindgren, there were two documents to be made exhibits this morning.

First is a memo we received on January the 25th from the Ministry of Natural Resources responding to the undertaking we gave them a week or so ago about transcript references to evidence on old growth forests in the MNR case.

And this document is five pages and we will assign it No. 1663.

---EXHIBIT NO. 1663: Two-page MNR memo, response to undertaking re: references to previous MNR evidence on old growth forests.

MADAM CHAIR: And the second document is a letter that was sent to the Board by the Canadian Paperworkers Union dated January the 9th, a two-page letter, and Mr. Pascoe's response to that letter, and

another letter from Mr. Pascoe referring the Canadian Paperworkers Union letter to the Minister of the Environment.

And this package has four pages and we will label this Exhibit 1664.

---EXHIBIT NO. 1664: Four-page document consisting of letter dated January 9, 1991 from CPU to EAB with EAB response and copy of EAB referral letter to Minister of Environment.

MS. BLASTORAH: Madam Chair, if I could, just for the purposes of clarification, I should point out to the other parties that the summary -- or the outline rather that was provided as Exhibit 1663 only dealt with the Ministry of Natural Resources' evidence and transcript references to the Ministry's evidence.

MADAM CHAIR: Thank you, Ms. Blastorah.

Okay. Mr. Lindgren, shall we begin with Mr. Maser. Welcome to Toronto.

THE WITNESS: Thank you.

MR. LINDGREN: Before we commence with Mr. Maser's evidence, Madam Chair, there are a few preliminary matters, not the least of which is marking a series of documents as exhibits.

I would suggest that we commence by marking the FFT witness estimate No. 6 as Exhibit 1665.

---EXHIBIT NO. 1665: Witness Statement for FFT Panel No. 6.

MR. LINDGREN: And following, that the next exhibit should be --

MR. MARTEL: Do want to slow down for a moment.

MR. LINDGREN: Sorry.

MADAM CHAIR: Okay, Mr. Lindgren.

MR. LINDGREN: The next exhibit to be marked is the CV for Mr. Maser.

MADAM CHAIR: That will be Exhibit 1666.

MR. LINDGREN: Thank you.

---EXHIBIT NO. 1666: CV of Chris Maser re: FFT Panel No. 6.

MR. LINDGREN: The next item to be marked is the supplementary source book which contains 77 photographs relating to Mr. Maser's evidence and it also contains an index to those photographs.

MADAM CHAIR: Okay. That's source book No. I.

MR. LINDGREN: It's entitled Supplementary Source Book.

MADAM CHAIR: These are the actual photographs. Yes, okay. That's Exhibit No. 1667.

MR. LINDGREN: Thank you.

---EXHIBIT NO. 1667: Supplementary Source Book re: FFT Panel No. 6.

MR. LINDGREN: Then we have three volumes of the documentary source book, and I would suggest that these be marked as Exhibit 1668A, B and C.

---EXHIBIT NO. 1668A: Documentary Source Book I re: FFT Panel No. 6.

---EXHIBIT NO. 1668B: Documentary Source Book II re: FFT Panel No. 6.

---EXHIBIT NO. 1668C: Documentary Source Book III re: FFT Panel No. 6.

MADAM CHAIR: Okay, Mr. Lindgren.

MR. LINDGREN: The next document to be marked as an exhibit is a source material entitled: Conservation Strategy for the Northern Spotted Owl, and it is by Jack Lord Thomas and others.

MADAM CHAIR: Okay. And that will be Exhibit 1669.

---EXHIBIT NO. 1669: Source material entitled: Conservation Strategy for the Northern Spotted Owl, by Jack Lord Thomas et al.

MR. LINDGREN: The next item, Madam Chair, is a copy of the Redesigned Forest, and I take it that will be Exhibit 1670?

MADAM CHAIR: Mm-hmm.

---EXHIBIT NO. 1670: Document entitled: Redesigned Forest.

MR. LINDGREN: And the final document, Madam Chair, I've placed on your desk this morning, this is an excerpt from the Wildlife Habitats and Managed Forest document and it's an excerpt containing Chapters 3, 4, 5 and 6 and appendices 11, 12, and 13 from that document.

MADAM CHAIR: That will be Exhibit 1671.

---EXHIBIT NO. 1671: Excerpts from Wildlife Habitats and Managed Forest document, containing Chapters 3, 4, 5 and 6, and Appendices 11, 12 and 13.

MR. LINDGREN: And those are all my documents at this time, Madam Chair. I would ask you to swear the witness.

MS. CRONK: Excuse me, Madam Chair. Sorry to interrupt, could my friend clarify for us what Exhibit 1669 was again; and, secondly, whether copies have been made available?

MR. LINDGREN: Exhibit 1669 is a rather large document, Madam Chair, it's a document relating to the northern spotted owl. It was referred to in the witness statement -- or actually the reference was omitted but we subsequently filed the document and it has been filed with the Board for some time.

We didn't make multiple copies available to the parties, Madam Chair, because of the shear size of the document, Madam Chair, but it has been available for coping or review if the parties had so wished.

MADAM CHAIR: We received this document December 10th, Ms. Cronk.

MS. CRONK: That's fine, Madam Chair, thank you. As long as my friend has a copy here, we can get it today.

MR. LINDGREN: That's the only copy, Madam Chair.

MADAM CHAIR: All right, thank you.

MR. LINDGREN: The next order of business, Madam Chair, is to swear Mr. Maser.

MADAM CHAIR: Yes. Mr. Maser, could you approach the Board, please.

<u>CHRIS MASER</u>, Sworn

MR. LINDGREN: Madam Chair, I would like to begin by briefly reviewing Mr. Maser's CV which has been marked as Exhibit 1666.

It's not my intention to review it in any detail, but there are a few items I would like to highlight for the Board.

<u>DIRECT EXAMINATION BY MR. LINDGREN</u>:

Q. Do you have a copy of your CV, Mr.

Maser?

A. Yes.

MR. LINDGREN: Perhaps if I could, Mr. Maser, I'll lend your copy of the CV to Mr. Martel. I'm sure you're familiar with what's on the CV. (handed)

Q. Now, Mr. Maser, I understand that you received an undergraduate degree and a graduate degree in general science and zoology; is that correct?

A. Yes.

Q. And I understand that you've conducted biological and forestry field research for over 20 years, primarily in the temperature coniferous forests?

A. Yes.

Q. And have you studied the forests of other jurisdictions or other countries?

A. Yes, I worked in the forests in the Himalayas and I spent a couple of years in Europe in a boarding school and then went back in 1985 to look specifically at forest problems, and I worked in north Africa in places where there used to be forests, so I've seen what's happened all over there.

Q. Okay. And I understand that you've occasionally lectured in biology, forestry and ecology

at various colleges and universities throughout the United States?

A. That is correct, and Canada for that matter.

Q. Now, on page 1 of your CV there's a reference to your involvement with the Federal Research Natural Areas System for the U.S. Forest Service.

I'd ask you to briefly explain what a research natural area is, and can you briefly describe the nature of your work?

A. The Research Natural Area System was set up to protect undisturbed areas of the ecosystem or different parts of the ecosystem such as different forest types, grasslands, so that the generations of the future would have a chance to look back and see what we have done to the environment on the one hand.

On the other hand they were set aside for educational purposes and for non-destructive research purposes to monitor processes, ecological processes and see how humanity is impacting those processes.

It's an interagency organization and all of the agencies, the Bureau of Land Management, the U.S. Parks Service, U.S. Fish and Wildlife Service Refuges, the U.S. Forest Service have looked over their areas to see what types of parts of the ecosystems need

to be set aside.

And I think it was 19 -- I think it was 1975, I forget, but we had a national meeting to take the northwest and look at what was out there, what did we have and what was missing, then try to fill in the pieces. We looked at it as an insurance policy for the future, I would say.

Q. And what do you mean by that?

A. If we liquidate all of the habitats for whatever reason and we make mistakes, then the future has no way to go back and find out whether what we did that was either right or wrong.

And there's some ecosystems, like in the Willamette Valley, the white oak ecosystem is gradually disappearing because there was very little of state lands and the farmers that own it have been cutting the oaks down for firewood for years and they're gradually disappearing.

You can think of it as John Magnusson calls the invisible present. They disappeared so gradually that over a decade all of a sudden we woke up and realized there's almost no white oak left, because during that decadal time frame no one was really paying attention.

So we thought, well, we have something,

we had best make sure that we set some aside and capture a few representatives while the opportunity was there.

Q. A few moments ago you referred to the Bureau of Land Management, and I understand that you worked for the Bureau for approximately 12 years.

Can you briefly explain what the Bureau of Land Management does and, again, can you briefly describe the nature of your work for the Bureau?

A. The Bureau of Land Management in essence got most of the land that the Forest Service didn't get. It was originally a -- it was originally the agency that gave land away in the homestead days, then it became the tailor of grazing service, where they adjudicated the grazing to make sure that they didn't overgraze the west, and gradually became the Bureau of Land Management.

The challenge in the beginning with the Bureau was it was simply custodial, they were holding the lands to give it away to private ownership and they were the lands like the deserts and the grasslands that no one saw a great value in.

In 1976 they got their own jurisdiction, and so now those lands are not to be given away and they are a full-fledged management agency. They

have -- for example, they take care of a lot of Alaska, particularly the fire. They own a lot of the -- they have jurisdiction over a lot of the west, they have jurisdiction over the outer continental shelf when it comes to oil drilling leases, they also are in charge of the mineral rights under a lot of the public lands and private lands on the east coast.

When they asked me to work for them it started out looking at range wildlife relationships and then it shifted to forest relationships because I was housed in a Forest Service research lab, and the reason for that was, I was the only research scientist that the Bureau had ever had and they didn't know what to do with me exactly, they just knew they needed some help.

And so I was housed with the Forest Service, and during that time there was -- we had a tremendous outbreak of bark beetles, and then three national forests came together and asked us to produce a document that would tell them how to manage the land, how to achieve what they wanted without destroying it, but not what to do, and that was where the Wildlife Habitats and Managed Range Forests came from.

Subsequently we did one for the Bureau of Land Management on managed habitats and wildlife habitats and managed rangelands.

Q. Have you been involved with old growth research with either the Bureau of Land Management or the U.S. Forest Service?

A. Yes. The last eight some years that I was with the Bureau of Land Management both they and Forest Service asked me specifically to move to the west side where I had come from to study the old growth forest issue, and that was what I spent the last eight, eight and half years of my research career doing specifically, was looking at old growth.

Q. Now, on page 5 of your CV there's a reference to the fact that in 1986 you testified at the Weaver's Congressional Hearing on Old Growth. Can you briefly describe the nature of that hearing and the nature of your involvement in it?

A. Congressman Weaver, as the congressional people do periodically, set up hearings so that, one, they can get a better idea of what is going on; and, two, to try and sift -- sort out what is going on between the struggle we have particularly in the northwest between the industrial view and the conservation view, and neither side has really dealt with the ecological view in the northwest; while the one fights over trees for this reason, the other fights over trees for that reason we're using the forest.

And so I was asked to represent the middle, to represent the ecological view, and it was in that vein that I testified.

Q. Your CV also indicates that you've served as a technical reviewer for a number of journals and publications including the Canadian Field Naturalist and the Canadian Journal of Zoology. Is that correct?

A. Yes.

Q. And I understand that you have also worked as an independent forestry consultant, and perhaps you can briefly describe the nature of your work as a consultant?

A. What I found when I decided to get out of the government was that there was a tremendous lack of understanding of what we think we know about the ecology of the forested system.

Scientists are not basically good at translating science for the average person. The conservationists are interested in their view, the industrialists are interested in their view, and they are all right from their points of view, but what was missing was some way of translating the scientific data that I've worked with with colleagues for so many years.

At the same time the Forest Service came along and said, we need to change but we don't know how to do it and we know that what we're doing is no longer working, we would like you to help us change. So what I have spent a lot of time doing is putting on workshops, going through what we understand about the ecosystem, then we pick their problems, we go out into the field and look at ways that we might solve those problems.

The other thing that I do is get the industrialists, the conservationists, industry, different industries like the cattle industry where there is an impact from livestock grazing and the Forest Service together and we go through a process of conflict resolution, getting down to looking at the forest and saying: How can we manage this so everybody can benefit, because the constant in-fighting is gradually destroying the system. There has to be a better way for people to deal with one another, and that -- I do a lot of that.

Q. And I assume that you currently work with the U.S. Environmental Protection Agency as a landscape ecologist. Can you briefly describe what is meant by the term landscape ecology, and can you explain what you're doing for that agency?

A. I gave the Environmental Protection Agency one year. They asked me if I would help them -- let me back up for a second. They have a new program, relatively new, called environmental monitoring assessment program and it's gotten off to a rocky start because most people look at land from a product base which gives whatever research questions we ask a human value, a slant of a human value whichs tend to hide the ecological relationships or misrepresent them in many cases.

So the Environmental Protection Agency first wrote and asked me if I would be willing to help them. Then I said: No. Then they called and I said: No, and finally I was persuaded. So I gave them a year, they gave me the title of landscape ecologist, which is not really what I'm doing, what I'm doing is helping them to refocus their programs so that they are in fact measuring and monitoring those things that are necessary to have as unbiased a view as possible of the changes that are taking place in the landscape either what they call natural changes or changes caused by human beings and then, secondarily, to look at the product output that society would like and see what impacts we're having on that.

Q. Now, attached to your CV we see a

publication list of approximately 200 publications. Is this a fairly complete or up-to-date list?

A. It's something over 200 at this point.

Q. There are a couple that I would like to highlight and ask you about.

I understand that you are co-author actually of the Wildlife Habitats and Managed Forests and in fact you're a co-author of the chapters that have been filed as Exhibit 1671.

Can you explain how you came to be involved in this particular project?

A. Yes. Jack Thomas, who was the man in charge of the lab that I was working, the Forest Service lab in La Grande when I started working for the Bureau of Land Management, was the gentleman who was approached when the three national forests that they called the Iron Triangle in northeastern Oregon, realized they were going to have to deal with the insect infestation and they were very concerned about not having enough data that when they started dealing with the beetle-killed timber they would do severely ecological damage.

Jack is trained as a big game biologist, and so his basic understanding of the ecosystem was

fairly limited and so he approached me and asked if he could borrow three days of my time for the Bureau of Land Management to help them put together an outline for a book and how it would have to be done, and that three days ended in 1979, so it took four years.

Q. And I understand that you did similar work for the rangelands in southeast Oregon?

A. Yes, we did.

Q. And you're also the author of the Redesigned Forest which has been marked as Exhibit 1670?

A. Yes.

Q. Publication No. 170 on your list is the document entitled: From the Forest to the Sea. And that has been reproduced, Madam Chair, in Volume I of the source book.

Did you have any comments as to that document?

A. That was the last official government report that I wrote -- I was part of writing. That was a culmination of basically the eight or nine years that I spent at the Corvallis lab working on old growth forest.

We synthesized everything that we could get our hands on at that time so that we hoped an

average reader would have a better understanding of what the issues were and a better understanding of how the system functioned based on what we knew today.

Q. And then finally, Mr. Maser, publication No. 194 on your CV list - this is on the last page of the document, Madam Chair - there's reference to your participation at an old growth conference held here in Toronto last year.

And can you briefly describe the nature of your participation in that event?

A. They invited a group of people to come to university and speak on old growth, trying to help the public to characterize what old growth was and was to them, and my charge was to deal with the basic ecological relationships. That publication has since come out.

MR. LINDGREN: Madam Chair, those are all the questions I intend to put to Mr. Maser about his CV, and I would move that Mr. Maser be qualified as an expert in forest ecology, wildlife biology, landscape ecology, forest management.

MR. MARTEL: Do you want to repeat them?

MR. LINDGREN: Yes. We're moving that Mr. Maser be qualified as an expert in forest ecology, wildlife biology, landscape ecology, forest management,

and the human interactions within and between landscape and management.

MADAM CHAIR: Are there any objections to Mr. Maser being qualified in this way?

MS. CRONK: I have no objections, Madam Chair, but I will have some questions with respect to those suggested areas of expertise.

MADAM CHAIR: Fine. All right, then Mr. Maser is so qualified.

MR. LINDGREN: Thank you, Madam Chair.

Q. Now, Mr. Maser, I would like to ask you to start by briefly outlining the basic message of your evidence for the Board.

A. This is not an ecological message that I'm going to give you, this is a view that I think we all need to adopt if we're going to resolve any one of these problems anywhere in the world.

When Jonas Salk, who was given commendation for developing the Salk vaccine, he was asked how it felt to have that scientific breakthrough and he said:

"There's no such thing."

The point that he made that stuck with me - because I heard this as a young person - was that:

"I had one piece of the puzzle...", he

said,

"...and I had no place to put it if it hadn't been for the thousands of other people who had put their pieces in first that none of us had ever heard of."

The other thing I've learned over time in courtrooms also is that I can't convince anyone of anything, including you, without convincing you -- for me to convince you I'm right, I must simultaneously convince you that you're wrong. At that point I have already stole your dignity and you can no longer hear what I say, therefore, I'd never try to convince anyone of anything.

What I bring is simply a gift of ideas, of data research and how we put it together and how we think we see the world, understanding that everything we do is but a working hypothesis, because the best that science can do is look at, measure, judge and interpret the apparent defects. We're not very good at getting at the causes.

I once gave a speech at the University of British Columbia in which I said that I didn't know scientific truth and I wouldn't if I stepped on it because I don't know a scientific lie. I still feel that way. The longer I've studied the systems, the

less I know about the systems; though we know a great deal, we really know very little.

There are a lot of things out there that we can't even identify, let alone begin to understand how they interact. So at best what I bring, to my mind, is a simplistic view of how the system works.

This brings me to a consideration of a comment Albert Einstein said at the end of World War I that:

"Science can no longer operate in intellectual isolation."

He realized that his struggle became that he was responsible for Nagasaki and Hiroshima, not because he had any idea of the bomb, but because he gave society the formula that led to the bomb. And his point was - and it is well taken, and even more so today - his point was that, we are responsible for the outcomes of our actions, whether scientific or otherwise. We can no longer isolate ourselves from the impacts we impose on society.

And as I look at what has been done to the environment in the name of science, there has been a tremendous amount of degradation because we have not yet learned that lesson.

I'm very uncomfortable ever being labeled

as an expert because to me an expert is someone who thinks he or she knows what the right answers should be and at that point can no longer see what the answer might be.

I think of it more that we need a beginner's mind which looks at the world as open mindedly as possible, ready to accept change and see what the answers might be because I do not find right or wrong answers.

And this is my point. If there is a river like we have in the United States, this is a river flowing this way, and this is a pulp mill, and the intake water comes up here and the effluent comes out down here and is polluting the river with dioxins, the normal struggle takes place inside here with the regulatory agency arguing with the pulp industry to clean up the river.

A simple solution, if we think beyond the norm, is not to argue about it but insist that the pulp mill put their intake below their output. At that point they are impacting themselves and will have to clean up their own act.

That is simply looking at the same thing with the beginner's mind and not getting stuck on the traditional view. The traditional view will slowly

destroy a lot of what the world has to offer. It has not worked in the past, it is not working today; we need to look at things differently.

Sitting Bull at the end of the Battle of the Little Big Horn told his people:

"Do not shun the white man's road because you must travel it. So take from it that which is good and keep it and discard the rest."

And he said:

"Our old ways are not all good either, so take from them that which is good and discard the rest and understand that you are renegotiating the reality of the future."

That is what we must do. These endless arguments between industry and the conservationists and this side and that side, while they argue about who gets what for what, we gradually lose the forest. We need to come together with a different reality of how we look at the world, we need to renegotiate that.

I have been in court, to my mind too often, and I find - as the last resort - but I find we either go to court to punish or to teach, and this is what I would like you to keep in mind.

If we go to court to punish and we win, what have we won? We have won the legal right to remain stuck within the rigid limits of our thinking; we have won the legal right to argue for and retain our fear of change and inner growth as human beings and we argue for our limitations at the expense of our potential.

If we wine, what have we won? We have won the legal right to humiliate our opponent because the court has awarded us our opponent's dignity, which is a legal trophy of conquest.

On the other hand, if we go to court to teach we are all winners because we're able to face one another with the courage to examine the issue, to allow each other the dignity to change without coercion and to help each other experience each other as we grow the process toward a new understanding and a new relationship in a viable resolution, the product, in which all parties emerge with at least a portion of their needs met. And the lawyers have the moral and ethical duty to truly act as legal counsel, not as generals in a futile endless battle, then all sides can emerge as winners with their dignity in tact, the only way humanity can truly win.

As I look at the world today I find there

are no longer individual winners and losers, humanity today wins or loses together. What you do to your forests in Ontario, what we do to them in Oregon affects the world as a whole, therefore, we are each other's keepers and we must act the part.

Q. I would like to turn now to the content of your witness statement. The statement itself is entitled: Economically Sustained Yield Versus Ecologically Sustainable Forest Including Old Growth.

I would like to ask you to explain what you mean by the phrase ecologically sustainable forest or ecologically sustainable forestry?

A. Something which is ecologically sustainable looks at what is necessary to maintain its integrity in an ecological or biological sense.

That, unfortunately, is not the focus of western society. Our focus is on the products and, therefore, we cease to see the forest.

Where you're sitting, if you look out here, you see the entire room, so you see everything in relationship, but the moment you look down to write your focus becomes limited and the room goes out of focus. When you look at the room you're dealing with the same as the forest in relationship, but when you

look down at the paper you're dealing with the product. We have become so product oriented that we have lost sight of the forest, so we deal with the products and not the processes.

Ecological sustainability looks out for the health and the sustainability, the ability of the forest to exist in a vital estate first and foremost, and then removes the products as the forest gives us the capability to do so.

Q. Perhaps I could ask you to slow down a little bit because some of us do have to take notes, notwithstanding our product oriented focus.

How does the concept of ecologically sustainable forestry differ from what you've termed economically sustained yield?

A. In the United States we have a law called the Multiple Use Sustained Yield Act. That was not the intent of Congress; Congress meant sustainable but they wrote sustained, which is the way it has been interpreted.

To sustain something at a given level is to make sure that it stays the same. They have even gone so far as to call it non-declining even flow. In reality what we're sustaining is not the ability of the forest to grow wood, what we are sustaining is the cut

of old growth. In fact we have upped that over the years. It used to be in the Willamette National Forest that when they cut out the big, big trees in the bottom they cut a certain volume and a certain number of acreages. In order to maintain the sustained yield of wood volume at higher elevations - which we've been doing since 1960 or so - they are cutting five times the acres to get the same volume of wood. That is sustained yield, that is an economic concept that has nothing to do with the biology of the forest.

Sustainable yield, on the other hand, would be removing from the forest on a sustainable basis that which the forest can give without impairing its ability to function and to in fact replenish itself, because the forest is more than just the trees. We have been focused on the trees and the sustained yield of wood fiber, period.

Q. Sustained yield has received a great deal of attention in this hearing, as you may know, Mr. Maser. I would like to put to you a phrase or an excerpt from the Class Environmental Assessment Document. And I'm am reading from page 97, Madam Chair, of the Class EA Document which is marked as Exhibit 4.

And on that page, Mr. Maser, there's a

discussion of the concept of normal forest. And further down that page it says:

"In Ontario's forests, where such conditions never exist, the practical meaning of sustained yield is continuity of harvest."

And on the next page, on page 98 of the Class EA, there's a statement that:

"Timber management is aimed at the organization of the forest to bring about this sustained yield of wood products in an efficient and orderly manner."

Do those statements reflect the problems that you have described with respect to sustained yield management?

A. Yes, they do. That is a product orientation, not a process orientation.

Q. And Forests for Tomorrow has proposed terms and conditions that stipulate that all silvicultural prescriptions in this province must provide for the ecological sustainability of the forest. Is that on objective that you would support?

A. Yes.

Q. Now, in order to practice

ecologically sustainable forestry, is it necessary to determine the ecological capability of the forest?

A. Yes, it is.

Q. And in general terms --

A. Particularly over time.

Q. And how would one go about doing that?

A. Well, we have spent a lot of years studying the forest, trying to figure out how different parts, components of it function because one of the things that we discovered fairly early on was that if you look at the forest from a strictly economic view everything that is not used by the human being is a waste; it is an economic waste however, it's not a biological or ecological waste. In a system that is functioning ecologically, there is no such thing as ecological waste, everything is recycled.

The challenge we face is in the Linearity of our thinking. Maybe I can use - I don't have it drawn out here, but if you will permit me, I will try and explain what I mean by the linearity.

And there are two ways of looking at any system; one is to see the system as a cycle, and the other is in thinking of looking at the thinking as a straight line, and this is the western European mode of

thinking.

And what that means is that when we looked at the forests originally, as we look at them in the United States today, we see production as -- production is okay - it's on this part of the cycling axle - production is here, decline is here, decline is not okay in yield.

In other words, the industry is not considered or our nation -- our gross national product is not considered healthy unless it's always expanding. You cannot continue to expand with what ultimately are limited resources, and a forest or trees are renewable in a sense but, over time, if we do not take care of the soil and all of the other components that create the forest, what we end up are limited resources, they are ultimately finite if we do not allow for their sustainability.

For example, if you have like a cake mix - if you ever baked a cake from scratch - there are certain ingredients that you put together and you know what they are, you know how they measure up and you learn what they do because if you leave one out, like baking powder, the cake doesn't do very well. That is looking at and understanding the system, the processes.

When we look at the forest today we look

at it like a cake mix and when you get a box of cake mix, if you pour it on the table you still have ingredients and then you add the other ingredients: egg, oil, milk, whatever; it still isn't a cake until you add the heat.

And this is the part that we forget when we look only at managing the forest for products, is that forests are not trees, they're the interactions of soil, water, air and sunlight, the chemical interactions, and if we do not take care of that part of the system then we simply will not have a forest; like if you do not add heat to this pile of ingredients, you cannot have a cake.

In linear thinking, which originated in forest management in Europe with the Germans, they saw it as a straight line because they built it on the land rent theory, which was an economic theory which stated that it is best to take the kind of tree that grows fastest and best on the site so you get the maximum yield for the minimum amount of economic input into the system.

And in their time that was right because what they were doing was healing forests, repairing those that had been devastated by wars, use of wood for energy, et cetera.

We adopted that in the United States with Gifford Pinchot who was trained in British colonial forestry in France. It's a utilitarian view of the system. And there was nothing wrong with it in the early days, except what we found is: If we do not allow the system to go full cycle, it becomes exhaustive and the system no longer produces the way it did, which in one of the references I sent up, Dr. Richard Plochmann, who is a German forester, has finally -- they finally reached the point where they're understanding this because they have been measuring the second and third rotations and they're finding by the end of the second rotation they may have lost 20 to 30 per cent of the productivity, because what they didn't do was take care of the soil first; what they did was focus on the product so much that they lost sight of the process and the system.

And we in the United States are facing the same thing, in fact world forestry is still looking at it in a product mode, and so we all face that problem.

Q. Mr. Maser, if production targets are set as a matter of policy and they're not based on the ecological capability of the forest, can it be said that you're practising ecologically sustainable

forestry?

A. No. And my basic concern with ecologically sustainable forestry is that I will always argue for an economically sustainable industry, but industrial economic sustainability can only happen if we first have an ecologically sustainable basis of the forest on which to secure the economically sustainable industry.

Let me put it one other way. To have -- the foundation is the ecological sustainability of the system, on that is built the economic sustainability of industry, on that is built the economic sustainability of the community, on that is built the economic sustainability of society. If we destroy the foundation on which this whole human drama is enacted, everything else will crumble like a house of cards.

Q. Does the ecological capability of a forestry remain constant?

A. No, it doesn't, and we may be rewriting all of the rules of global greenhouse warming.

Q. And if the ecological capability does not remain static, how does one go about dealing with changes such as global warming?

A. Well, to enter that I'm going to have

to give you a brief overview of how we think the system works, so I can put this in perspective.

MR. LINDGREN: Madam Chair, I would suggest that once Mr. Maser has completed his review of the flip charts we'll mark them all as an exhibit.

MADAM CHAIR: All right, Mr. Lindgren.

THE WITNESS: Can you see okay?

MADAM CHAIR: Yes, fine, Mr. Maser.

THE WITNESS: Can you see, sir?

MR. MARTEL: I can see it, the only problem is that--

MADAM CHAIR: He couldn't see through you, Mr. Maser.

MR. MARTEL: --I couldn't see through you, I'm afraid.

THE WITNESS: Oh, that's what I was concerned about.

MR. MARTEL: A slight problem.

THE WITNESS: That's why I wanted to move this. Can you see it now, sir?

MR. MARTEL: Yes.

THE WITNESS: Okay. If we look at a geographical area of the world, you can pick any area you want to because so far as we have been able to determine they all function somewhat the same.

There appears what we would called Gaia, the Gaia Principle, which is the earth's surface as a whole. Pick a geographical area. There are four things which limit what that area can do in responding ecologically; the first one is the geology of the area, we would consider that to be the hard limits, that sets the stage for everything that happens inside.

The geology in large measure determines the macroclimate, the overall climate; those two together determine the topography, and that is also then determined by the parent material, which is the original rocks from the geological process, those are the hard limits; and within those limits are then determined what we call the three soft limits, the disturbance regimes such as fire or earth flows, things like that. That in effect -- that affects the hydrology which in turn determines a lot of the microclimate, the topographical microclimate.

Now, these three things are flexible and they change over time - over the short run, geologically speaking - and they are controlled by these hard outer limits.

The next layer would be the soil. The soil is the placenta of the earth in a sense, it's the membrane which is both living and non-living, it

integrates the parent material with living organisms, so it is a membrane of continuity between the two.

Within this system are the individual organisms which make up the species, which collectively create the communities, which collectively create the landscape that we then divide up in our minds and call ecosystems, and ecosystem is an arbitrary term, to take out a segment of the landscape and say we are going to study this in its integrity, that is what we call an ecosystem.

I had a lot of problem with that because to me the world is an ecosystem, but if you divide out a small area that would be considered an ecosystem.

The culmination of all of this geological activity over time is this little central area that you can think of as a ball, this blue ball here in the middle, that is the condition that we inherit as human beings.

Now, the point that I would like to make is, and the point in science and in the monitoring effort the Environmental Protection Agency is making, is that this system must be viewed as value neutral; nature does not assign values to ecological processes, only human beings do that, and it is a real struggle to be unbiased, in fact I don't think the human being can

be unbiased, I do not think we can hold an unbiased thought.

But if we look at and study these processes, as we have been doing, outside the realm of product, outside the realm of conservation, outside the realm of industry, we have been trying to understand how these things influence one another because individuals collectively can influence the species, they influence the community, et cetera, this is in a constant flux, it is never the same.

What we are constantly trying to do is predict the interactions that go on here. What we can as a species, as individuals that become a species, that become human communities that affect the landscape, we are changing this hard limit, the macroclimate with global warming, and because we have the ability to impact this part of the system, as Einstein pointed out - and since World War II, I might add, we have the ecological and technological capability to completely disarrange the world's ecosystem - as we are doing with macroclimate.

That is going to shift all of these other parameters, and we don't know how that's going to react because it will be an unprecedented warming based on all of the predictions.

So the thing to keep in mind is initially we must look at the ecosystem and study it as though it has no values, it is, and whatever it does you can say it's beneficial to some parts of it and detrimental to others.

The other point is that over geological time and in most of the discussions I've had that have centered on the conservation controversy, time is an element that is excluded. We cannot exclude it, because we may have inherited the system here that's been here, it's been all over the map over time, so what we inherit is a dynamic system which is constantly changing. It is not a constant in time or space, but we look at it in both time and space and we think of it as a constant, particularly forests because they're the oldest living things on earth and they do not appear to change much, but if you have a thousand year old tree, that is several human generations that have lived and died within the lifespan of that tree.

So then we had to figure out: Now, how do we deal with culture in all of this, and so we superimpose culture over the top of it. The blue ball, what we inherited, are the natural limits. Now, this is where the value is added and this is human value which very often cannot be equated to dollars and

cents.

But there's something interesting that happens when humanity imposes its value on the landscape, and we could look at the same acres. The pattern of human thought, in this case cylic, which is process thinking, which is the way the native Canadians viewed the land, gives you a culture that is based primarily on religion and sees the entire landscape as a thou, that which is holy, that which is to be revered and to be part of.

What the native Canadians and the native Americans are still practising, more so - not like they used to, but more so than a lot of the rest of us - is understanding the real concept of resource. Resource as it was originally defined was a reciprocal relationship between humanity and the earth, to be the source of again, to resource, to give something back for what has been used.

If you look in the dictionary today resource is defined as a way a nation measures its wealth, something to be converted into money. In other words, what is out there is not okay, it has no value unless it is converted into dollars.

If you go back to the way the natives tend to see us still, religion underneath and then

comes economics and institutions, and this whole set of circumstances defines their survival as a culture.

If you look at our traditional western way of looking at the system, our economic view, the pattern of human thought is linear and, therefore, it focuses on products. We want to straighten out the system and whatever it is out there has no value unless it can be translated somehow into money through a product.

Our culture then has economics first, then the institutions, and religion is last, and it is an it, it is a commodity, something to be converted into money, we do not see the land anymore as holy, and all you have to do is look at what institutions dominate Toronto; the churches in stature or the buildings that deal with economics. That gives you a clue of what our thinking is.

Now, neither of this is right or wrong, good or bad. The point I'm making is that whatever your thought process is in this configuration, that is what will be imposed on the landscape, and so the two things that make the difference are the thought patterns, how we view the landscape. That is the reality with which we have negotiated with nature.

On the one hand the capitalistic --

straight capitalistic system, without a great deal of humility - which I would say of science and technology also - has the capacity to destroy the system because it sees it in the linear product mode.

On the other hand, the native view is not necessarily the panacea either, we need to combine the two. And there's a way of doing that, but to do that we must understand that the ecosystem siphons. Now, that doesn't mean it's a neat circle and it doesn't mean that you can't have things like plantations. It depends how it's done and with the attitude with which it's done.

For example, if you look at this, this is a cycle, and there's a linear part over on this side, it's a fairly straight line. The reason it's a cycle - and it can be any configuration - is because it comes back in time and approximates its beginning. That is the critical point.

Left alone nature may burn a thousand acres and it will grow for 30 years and it gets burned again and burned again, but ultimately in time it is allowed to come back to approximate its beginning through the old growth process, through succession, and then again it can be -- it is cycled and cropped.

Now, how it cycles is determined by the

geology, topography, parent material, the macroclimate, the hard outer limits. Within that is the play of the disturbance regimes such as fire, hydrology, microclimate and then the soil.

Within that are the individuals, the species, the communities and the microclimate which are pushing and nudging against those limits. So while this one may remain relatively fixed; this one is squishy and can move around and there's a constant interplay between these soft inter limits and the organisms that make up that cycle.

But the key is that it must come back and approximate its beginning or the processes do not function, because this cycle, this area of the landscape, if you look at it ecologically, is a living organism.

It's no different than my leg. If I break my leg skiing and I go to the doctor, he can put a pin in it and he can put screws in it and he can put a cast on it, but he can't heal it.

We found that we can't fix the forest no more than a doctor can fix my leg. We disrupt the processes as part of management, that's is okay; we break part of the system, that's okay; but we can't fix it because it's a living organism.

What we can do is plan in our management enough time to allow it to heal so that it can be cropped again. So what we're doing in essence, through allowing it to cycle all the way, is replenishing the soil nutrient capital, allowing the processes to heal so that once again at some point in the future it can be cropped, it can be used, and then by allowing it to rest and rejuvenate, we are being the source of its survival and ability to be used again.

This is an important concept because ecosystems, as are societies, are self-organizing cycles, they're self-organizing entities, and what I mean by that is, a forest will remain a forest so long as, for example, soil fertility, soil organic material and soil processes are not degraded to the point that it loses its vitality as a forest. We have lost many acres in the United States. What happens with most cycles is that they go around, and if you think of this -- are you familiar with bob sleds by any chance?

MADAM CHAIR: We know what they are.

THE WITNESS: Okay. If you think of this as the bob sled track, two of them together, they can be circles or they can be some other shape, but they have to touch so that there's a common boundary. If the bob sled here goes around and around, what happens

is in a system it tends to go a little bit faster than just holding its own, so it would creep up the side.

A self-organizing system organizes itself to a critical point and then there's a catastrophy which sets the system over and re-organizes it again, and all of the systems that we know of act this way, including earthquakes.

So if you think of this as a forest and it goes around and around and the bob sled climbs to the edge, all of a sudden it flips over the top and it starts cycling this way and re-organizing, you may have a grassland or shrub field.

If we do not keep this forest cycling within the limits of forest, we can flip it over the top and end up with shrub field or grassland which now does not produce trees, potentially it can, but we have found from some of our mistakes that the energy it takes in human years, in investment of fertilizers, silvicultural techniques and so forth to get this back into forest is incredible and it's far more costly than if we had kept it cycling within the purview of the forested ecosystem to begin with.

So understanding how this cycles and keeping it within that purview is much less expensive, particularly for the generations of the future.

Systems, as we understand them, are like balls up here. There really is no such thing as ecosystem stability as far as we can determine, it's constantly being rocked back and forth up on this little nob. Now, what happens is periodically we push it off, we shove it down. Let's say, we suppress fire, if we suppress fire long enough we build up fuel loads, et cetera, all of a sudden rather than the normal creeping ground fires - which I'll talk about a little later - we have one which is a real blow out and it really burns fire.

Now, what that has done is pushed the forest down here into a shrub field, and may stay as softwoods, go to hardwoods, it may be there for years, but given enough time it will recoup and will gradually go back to a conifer forest.

But if we do this with something like global greenhouse warming or soil exhaustion as they have done in places in China, then what we do is we push the ball over here and it gets down in this trough and it cannot get out. This is probably the most stable part of the system, such as our deserts which used to be grasslands and we overgrazed with livestock in the southwestern U.S. They are far more stable now and less productive than they were, and the tendency

we've found is for these systems to go down, and if they cannot go back up, then they have lost productivity and the spiral is down.

Now, we have done this in a number of areas, and the reason we've done this is that we have focussed so hard on the product that we didn't understand the processes.

There's something that's important about that concept and this has taken us a long time to understand. There's a lot of talk these days about biodiversity and the loss of species. I would submit that that is not nearly so important as the introduction of things into the system that it has not evolved to handle; for example, substances.

In the United States we used to hunt with lead, I don't know -- hunt ducks with lead shot. I don't know what you folks use up here. But we found that the lead collected in the lakes as a foreign substance that the system was not equipped to deal with and the tremendous lead poisoning of the ducks during the non-hunting season because they were picking it up off the bottom. The system couldn't deal with that, so we began to lose ducks, individuals, whole populations. It endangered the Pacific northwest flyway of some species.

Then there was the introduction of foreign practices or processes, and one of those would be clearcutting, one of those would be roading, and there's nothing wrong inherently with clearcutting or roading, but the thing to keep in mind is the system, it has not evolved to deal with these practices, and so what we are now doing is shifting the way that whole system functions.

The other thing is technology. We are imposing on the system a technology and a thought process that goes with the technology to which the system has never before been subjected. We are changing the system, having a greater impact, by introducing things that are foreign to the system than we are by removing some of the pieces, but those pieces that are removed are all removed, so far as I can determine, by what we introduce.

So we have come to the conclusion that the introductions of foreign things have a greater impact on the system, like radiation, in large doses.

When Chernobyl blew up in 19 -- whenever it was, a few years ago, that had tremendous impact, but there was some buried dump that blew up in the Southern Ural Mountains in 1957 or '58 that sterilized roughly 1,000 square kilometres and it vaporized off

the face of this earth villages and people and animals, orchards, et cetera. That is what I mean by introducing something foreign which then disrupts the system's ability to function. The Russian scientists to the best of their ability think that area will be sterile for centuries.

The other thing we found then that whatever we introduce like that ultimately has greater impact than taking something away. Fire suppression is taking away a process of fire.

Now, we can have an impact on the forest, but if we reintroduce the fire that is a reversible process and everything over time, if you remove time as an element, everything in the earth is reversible to some point, but the system may never go back to what it was; and the system will heal itself, but we are looking at this in practical human terms, and so we have to be clear on the time lines we are talking about.

So if you take away fire suppression, you can have the system heal in a few years by reintroducing it, you can bring the system back closer to what it was.

Foreign in this sense to me means that something has been introduced into the system to which

the system is not adapted to deal with at the moment but, given enough time, it can probably adapt. For us the question is: Will humanity have enough time for the system to adapt before we have destroyed that which we have.

Now, if you think of the ecosystem as a milking stool - you're familiar with the three-legged milking stools - this is biological diversity the way we traditionally viewed it; if you lost one species, the stool would tip over. And these three legs on the stool are soil fertility, biodiversity and genetic diversity.

But we have found that the system has built into it a great deal of redundancy in processes and systems, so rather than a three-legged milking stool we really have a six-legged milking stool.

So we can remove one piece, we can lose a piece out here and the stool won't fall over, but if we lose two pieces, two legs, we have to be very careful where that second leg is because if both of them are lost here, then we have disrupted the system drastically.

But if we lose one here and lose one here, that is probably no big deal, we can probably lose a third one. The point is we don't know what

we're losing or where, that's the caution.

And ultimately in forest management - and forests will be managed and they should be - we need to look at the system and ask ourselves some other questions. If we know what the natural stresses on the system are, let's say, high elevation, northern latitude, short growing season, extreme temperatures, whatever, if we can measure this, then we know on a scale of zero to a hundred per cent where along this line that the stress limits of that system are, and within the limits of its natural stress all systems are productive, but they are not all as resilient as other systems.

Our high elevation forests are not as resilient as the low elevation forests. The low elevation forests have almost zero by comparison to natural stress. So our range of management stress can be much higher and not lose a system's ability to have sustainable processes.

But the higher the natural stress on the system is, the lower our management stress must be in order to maintain the system within its limits of resiliency, its ability to bounce back.

And we do not look at the systems this way when we manage yet. I think we're moving in that

direction, but this is the direction that ultimately we have to go, because what we need to maintain, to my mind, in sustainability is the ability of the system to adapt to change, which is an ongoing process; because if we don't, we won't be the losers, but the generations of the future will, and that to me is the crux of the issue.

MR. LINDGREN: And, Madam Chair, we will pick up on some of the implications of what Mr. Maser has described in further portions of the evidence.

Q. If I could, Mr. Maser, I would like to ask you to turn to page 3 of the witness statement.

MS. CRONK: Excuse me, Madam Chair. Are the flip charts going to be marked as exhibits? It's going to be difficult now to relate the witness' evidence to the documents that he has just referred to.

Was it my friend's intention to mark them? It would be of great assistance to other counsel.

MR. LINDGREN: Yes, that was my intention, Madam Chair.

MADAM CHAIR: All right, we're going to give it one exhibit, Mr. Lindgren.

MR. LINDGREN: Yes, and I'll mark them as A, B and C and following.

MS. CRONK: Sorry, Madam Chair. Could I request that there be some description by the witness of the various flip charts for each of these rather quickly. The transcript is going to be, in my respectful submission, incomprehensible on these documents unless we have some identification.

MADAM CHAIR: All right. Could we mark those. And, Mr. Maser, as we turn the page and mark each of the pages of the flip chart, could you just briefly describe what it was--

THE WITNESS: Yes.

MADAM CHAIR: --so that we give it a title.

THE WITNESS: I would be glad to.

MADAM CHAIR: Thank you. And this will be Exhibit 1672, and A is...?

---EXHIBIT NO. 1672: Series of flip charts introduced by Chris Maser during evidence (Pages A-K).

THE WITNESS: A is the traditional way in the United States that a pulp mill is situated on a river with its intake and output of water.

B is a different way of looking at the same thing, where the intake is below the output which causes the mill to pay attention to its effluents.

MS. CRONK: Could I ask the witness to

slow down just a bit, Madam Chair. Some of us are trying to get it down.

THE WITNESS: Oh, Okay.

MADAM CHAIR: Thanks, Mr. Maser.

THE WITNESS: That's what happens when I get excited.

MS. CRONK: B...?

THE WITNESS: B is a different way of looking at a pulp mill when the intake pipe is down river from the effluent pipe and the mill is then forced to deal with its own effluent rather than passing it down river.

Okay? Well, I'm waiting for you to be done writing.

MS. CRONK: I'm not the relevant person, sir, the Board is.

THE WITNESS: Oh, okay.

MADAM CHAIR: We're all set, Mr. Maser, go ahead with C.

THE WITNESS: Sorry about that. C is looking at the hard limits and the soft limits of a geographical area in an ecological sense with the soil as the interactive membrane between the living and non-living components of that area and the living components in the centre, which is a way of looking at

the system to see where the impacts we are having are going to be interactive with various components of the system.

And this needs to be looked at in value neutral. There is no human value imposed on this part of the system at this point.

MADAM CHAIR: Part D?

THE WITNESS: D is simply pointing out that the central part, which is the blue dot that we inherited at any given point that we happen to approach the system as human beings, has changed drastically over time and will continue to change.

There is nothing static about ecosystems, they are dynamic and constantly changing and we must, therefore, adapt to their change; they will not adapt to our static view.

MADAM CHAIR: And E...?

THE WITNESS: E is superimposing a human value set on the landscape from the perspective of cylic thinking or process oriented point of view. This is value added from a human perspective.

F is the same general view, except now we're looking at a system that is linear, that is western economic thought and is concerned with products not processes. And it is very different negotiation of

reality with the natural system, and it too is value added.

And neither system is right or wrong, they're different, and they both have their compatibilities and they both have their drawbacks, and we must put them together.

G is looking at an area as a cycle and explaining that a cycle is not necessarily a circle, it can be any shape and have straight lines. A cycle can to a point be linear, so that we can fit a plantation mode into the cycle of sustainable forestry provided it is done prudently and wisely and we allow the system to go full cycle on these acres at some point to replenish themselves.

H is simply demonstrating that all systems organize themselves to a state of self-critical organization at which point there is a catastrophic change. There are lots of little incremental changes, but as the system organizes to a state of critical change, critical mass, all of sudden there's a catastrophic change and the system then begins to cycle in a different way and reorganize differently.

We have the opportunity in management, to some extent, to control how the system cycles by what we do it, and it would behoove us to maintain the

cycling of forested acres in forests if we want forest products, rather than allowing it to shift to a grassland land or a shrub field by extracting more than the system is capable of dealing with.

I simply shows that a system is on a balance of a peak, it is not a stable entity, it's always in dynamic tension, and the ball -- or the system changes and it can go to a lower state of productivity, a forest to a shrub field, for example. This can happen without human intervention, it often does, with fire, or it can happen with management, but given time, since what we're doing is taking something away in a sense, if we give the system the opportunity to heal itself, it can go back and approximate its beginning, it can complete that cycle and be forest again.

On the other hand, if we remove too much or have too great an impact, we have the option of shifting it to a shrub field or, in our case, a grassland to a desert so that it may not, within any human frame of reference, be able to go back to what it was.

And we have found that any time the system goes down, it spirals downward in productivity, the ability for the system to maintain its net primary

production goes down. So we have lost, from our point of view, some productivity of the system; from the system's point of view, it makes no difference. The point here is, we need the system a lot worse than it needs us.

J is simply pointing out that we have greater impact on an ecological system by the substances, practices or technology we introduce to the system that are foreign to its ability to cope than we do by actually taking a piece away from it because of the built-in ecological redundancy with which the system has evolved to withstand the shocks of these changes.

This is the resiliency. We interrupt the resilience of the system with introductions and to a far greater extent than we do with withdrawals until, as in the tropics, we're beginning to take away more than half of the species.

When you remove a species from a system, you don't just remove the species, you remove the processes that that species was part of and every time you remove a process, the system shifts a little bit, even with redundancy, to make that up. If we remove enough of the redundancy, you can cause the system to collapse.

K is simply looking at the system from a point of natural stress versus management stress and how do we balance the two so we can have a forest and an industry on a sustainable basis.

MR. LINDGREN: Thank you, Mr. Maser.

Q. Now, a few moments ago you were discussing the European utilitarian view of the forest and we find the discussion of that issue at page 3 of your witness statement.

Can you advise me as to whether or not, in your opinion, whether or not that paradigm is still prevalent today?

A. Yes, it is.

Q. Now, as you may know --

A. It is in fact changing in Europe, in Germany faster today than it is in the U.S. even.

Q. As you may know, the stated purpose of the MNR's timber management undertaking is to provide a continuous and predictable supply of wood for Ontario's forest products industry.

Does that, in your view, reflect that utilitarian view?

A. Yes. In fact to me it is not even realistic, regardless of where it is, because when we look at forests as plantations or farms or we're

growing trees as a crop, every farmer faces the vagaries of the climate and weather on an annual basis and, to my knowledge - in fact, I find it rather curious that there is any industry in the world that deals with "renewal natural resources" that doesn't want to risk the same type of things that every farmer has to risk.

There are no independent variables in the world and we tend to look at independent variables, and we can isolate variables such as tree growth if we put on blinders to the rest of the system and look in a very short time, but if you look over time there are no variables. Soil fertility changes, we are altering the quality of the air which has an impact on the forest.

So it seems to me that since the system is changing it is incumbent on the human being to adapt to the system, rather than trying to force the system to adapt to our desires because, in the long run, that has never proven to work anywhere in history in the world and I think it's time that we begin to understand that.

Q. Now, throughout your witness statement you have sometimes used the term industrial economics.

A. Mm-hmm.

Q. Does the provision of a continuous and predictable supply of wood for Ontario's forest products industry represent industrial economics in your view?

A. If you look at it in the straight linear sense, yes, but it is not a sustainable economic.

In the United States our industries are in trouble for a number of reasons - not all because of the spotted owl, by any means - one is, the forests have been grossly over cut, because to maintain a sustained yield means a sustained cut, because you're cutting and you're not growing it as fast, it is not -- you can cut a lot faster than you can grow, and the other thing is, it's standing there, that is a much greater certainty than growing an acre of forest.

Nobody can guarantee me that they can grow an acre of forest 120 to 200 years because we don't control insects, we don't control fire. As we see we're altering the climate, but we can guarantee that we can cut it down. That's the only guarantee that I know of. I'm not making a value judgment, that's simply the way the world stacks up.

Looking at it from an economic view then, sustainable -- economic sustainability depends on the

ecological sustainability of the system, and that has limits on it, which means that sometimes you can take more and sometimes a little less, but that must be balanced with whatever the forest is capable of producing, and that's not a question we ask.

Q. Do you have any comments or views on the distinction between timber management and forest management?

A. Yes. Timber management is tree management; forest management takes everything into account, including soil fertility, the mycorrhizal component, the processes belowground and human values other than products.

Forest management is learning to understand the whole system and how do we sustain its ability to adapt to a changing climate, not just today but in perpetuity for the future, so long as human beings are able to inhabit this planet. That's forest management.

I don't know of that being done anywhere in the world, in the mechanized world. It isn't done in the United States, it's not done in Europe.

They used to say that sustained forestry or sustained yield was selective logging, but in Norway within the last few years they went to clearcutting

because of the drastic decline of production -- of wood fiber. We had a Norwegian scientist with us for a couple of years at Oregon State in the forestry sciences lab when I was working there, and he was concerned that in Norway too they had had, I don't know how many, centuries of selected harvest but ultimately they had exhausted the soil, and so when the yield went -- when the decline came in, they went to clearcutting and they lost a whole softwood forest.

What happened was it went to hardwoods, which was the best thing that could happen. Hardwoods revitalize, that's nature's -- like, we have alternate cropping in growing corn, this crop rotation, that's nature crop rotation in essence.

They will get their softwoods back, but it will be a while. And so that is part of the forest cycle also and that must be taken into account.

Another way of looking at it is when we clearcut in the Pacific northwest, for example, there's a shrub that comes in called ceanothus velutinus (please don't ask me to spell that).

Q. I think the court reporter might, but go ahead.

A. I'll take a whirl at it a little later then.

It comes in following fire, like broadcast burning after cutting. It also has nitrogen-fixing nodules on its roots and it happens to be able to maintain four or five species of mycorrhizal fungi that are compatible with Douglas-fir on site, so that when the first seedlings are planted there is a ready inoculum there of site-adapted mycorrhizae.

We herbicided that for years, we still do in some places because we're only focussed on the trees, but as we begin to understand this - and those areas that have it, they're now beginning to manage for interplanting trees, they're maintaining a certain level of this shrub because it does something very beneficial in preparing the site for the next forest, the next stand of trees. That is forest management.

Timber management would herbicide that because they see it as competitive with trees, with wood fiber production. Timber management is wood fiber management, as I have seen it practised.

Q. On this point I would like to refer you to a statement that you make on page 4 of your witness statement and this is towards the top of the page in the first full paragraph.

A. Mm-hmm.

Q. And the second line of that first

full paragraph indicates that:

"The practice of forestry initially is timber management, that ultimately becomes regulated plantation management based on economic concepts that have nothing whatsoever to do with ecology and the ecological sustainability of forestry."

A. Mm-hmm.

Q. Can I ask you to explain what you mean by that, and perhaps you can start by indicating what you mean by plantation management?

A. Plantation management is planting trees in rows to maximize the product, to maximize the yield of wood fiber while minimizing the cost of achieving it. And again, there's nothing wrong with that per se, it's no different than planting corn, it's an agricultural mode of operation, but that is not forest management because forests are built on the accrual of biological diversity, diversity of processes, diversity of things like large trees, snags, logs, things that recycle and a forest becomes complex and it becomes self-regulating.

As I was saying here before, it becomes self-organizing to some point. What we're doing in

this case is straightening out the cycle. The idea is that we can cut plant, cut plant, cut plant ad infinitum, never lose the yield and never have to allow the system to go full cycle. That is what -- we are trying to constrain the ecological system rather than adapting to it, and I don't know of anywhere in the world that has worked for very long.

In fact there is a book by John Perlin, which I think I have mentioned, that traces back deforestation in the world 4,700 years to Mesopotamia and shows that none of these have succeeded over time. In fact, there are places in Europe where the land in ancient history used to be a seaport and today is 13 miles inland because deforestation washed out all of the top soil and it spilled land out into the ocean, so now some of these port cities are no longer port cities.

We have the capacity of doing the same thing if we do not heed the regulations nature gives us which are unyielding. We must yield; nature will not.

MR. LINDGREN: Madam Chair, were you planning to take a lunch break at this time?

MADAM CHAIR: We certainly are, Mr. Lindgren. We will be back at 1:30, Mr. Maser.

THE WITNESS: Thank you.

MADAM CHAIR: Thank you.

---Luncheon recess taken at 12:00 p.m.

---On resuming at 1:35 p.m.

MADAM CHAIR: Please be seated.

Mr. Lindgren, I forgot to make something an exhibit this morning. Can we add --

MR. LINDGREN: Certainly.

MADAM CHAIR: These are the Affidavits of Service for the hearings, the satellite hearings we were on last fall by Tracy Tieman dated December 14th in relation to the mail notices for the Timmins satellite hearing.

MS. BLASTORAH: I think there are actually some for other than Timmins, Mrs. Koven. As you're aware, that was when Ms. Tieman was away on her honeymoon. I think there were some for Espanola and others as well.

MADAM CHAIR: Yes, let's go through -- this is the entire package for all the satellite hearings?

MS. BLASTORAH: The Affidavits that were outstanding. We did file some as we went along.

MADAM CHAIR: Yes.

MS. BLASTORAH: And the remaining ones were to be filed, as per my discussion with Mr. Pascoe,

at the time upon her return.

MADAM CHAIR: All right. Well, I just have a notice here or note about the Timmins hearing, so when Mr. Pascoe --

MS. BLASTORAH: I think it should indicate on the Affidavit, but perhaps we could sort it out at the break.

MADAM CHAIR: Yes. This Affidavit only refers to Timmins.

MS. BLASTORAH: I will sort it out with Mr. Pascoe on the break.

MADAM CHAIR: Let's give it an exhibit number, 1673. Thank you.

---EXHIBIT NO. 1673: Affidavit of Service re: satellite hearings.

MADAM CHAIR: Go ahead, Mr. Lindgren.

MR. LINDGREN: Thank you, Madam Chair.

Q. Mr. Maser, earlier in this hearing the Board has heard evidence from the MNR that the aim of the MNR is to transform the natural forest into the normal or fully regulated forest containing balanced age-classes and commercially desirable species.

I have two questions for you about that approach. First of all, in your opinion, is it ecologically necessary to bring the natural forest into

this so-called managed state; and, secondly, having regard to the set of factors that you have set out on page 5 regarding nature's design versus man's design, do you have any concerns about an approach that would attempt to bring the natural forest into a managed state?

A. Your first question was, is it ecologically necessary?

Q. That's correct.

A. No, it is not. It might be economically desirable, but it's not ecologically necessary.

As far as concerns, it's unwise, let me put it that way, because what we're doing is what I talked about this morning, we're introducing a strategy into the system that nature is not designed to cope with, it has not evolved ecologically.

If we, for example, try to make the unpredictable -- try to entrain the forest, like a stream, if you've got a stream that has meanders and you cut off the section here and you straighten it out in a channel like the U.S. Corps of Engineers has done all over the U.S. and then you cut off a piece here and you straighten it out and you maintain an area of "natural" inbetween, ultimately you destroy the whole

thing, because any system -- any ecological system dissipates energy - we call it the dissipated system or dissipated structure - and when you entrain something, when you straighten it out, it's like putting it in a straight jacket, it's got no way to dissipate a lot of this energy.

In streams, they destroy their banks and the channel ultimately; in forests, you end up shifting it to a direction you don't want it to go in necessarily if what you would like is to have sustainable timber production.

I found it interesting in the timber industry in the United States, for example, that they talk about old growth being overmature and that we've got to regulate the forest and get them into young stands but, at the same time, they covet the old growth as the highest economic value. Those things to me seem to be incongruous.

The other thing that occurs to me, looking at it again from a human point of view as well as ecological, if the system has produced something that we like, something that is a benefit to us, to alter the system to produce something else or to take a chance on shifting the system's ability to function to me does not make sense, it's like saying if something

works, don't fix it.

If you take the second part in looking at landscapes, one of the arguments that has come up in the court in the United States over and over and over again - the courts I've sat in on - is just a few acres of old growth and it's falling apart, it's overmature, whatever, and can't we just cut this. You can, but if you do not look at the watershed or water catchment, if you do not look at the landscape as a whole, we're treating this in bits and pieces out of context of the whole, and the challenge with that is that we end up not understanding what we're doing. I can give you an example.

A few years ago a wildlife biologist came to me and he was very upset that the forest supervisor wanted to cut one acre -- it was one mile of stream side old growth forest, and he said: But there's almost none left. Well, they couldn't see that because they were just looking at a small unit at a time, which is no different than a big unit, you're still not looking at it in the context of the landscape.

And so I had him draw up the stream units and colour code them, then I had him draw up all the acres along the streams that had been impacted, and what it turned out, when the forester saw the landscape

in context with the unit, they were going to impact one tenth of what was left in tact in that area and they eliminated the sale, they let it go, they didn't sell it, because now he had a different view, he had a view of this in the context of.

And the landscape is not just space, we have to look at these things in time because it's a dynamic dance between space and time in ecosystems, it's not static, you cannot put a fence around it and say it's going to stay here, which is what we try to do in management with all kinds of things, including farm fields.

In dealing with diversity --

Q. And you're referring to Item No. 3?

A. Item No. 3.

Q. On page 5.

A. Right. I appreciate that, I will add the numbers.

Diversity is becoming more important but we need to define which diversity and in this case the diversity which is showing up as the most important is genetic diversity in the face of global warming, because genetic diversity is frequently a secret extinction that we don't know about.

The argument has been in the States, for

example: Well, if you have one parent of Douglas-fir - this is the pure geneticist's argument - if we have one set of Douglas-fir, that's all we need, we can populate the west with this parent stock. You can, but it probably won't last because the flip side of it is that the mycorrhizal fungi and the other symbionts in the soil which interact with the fir's roots, very often we're beginning to find are not only site-adapted, we're beginning to think there's genetic compatibility that has evolved between the above and belowground part of that system. And so if we ignore that, then what happens is that we lose these genetic combinations.

And that type of diversity in the face of changes that we have no way to predict, we've got no idea what's going to happen are critical. They're the insurance, they are the -- it's like buying insurance for the forests of the future, it gives us the best chance of having a resilient forest.

So to me it is unwise to eliminate that when we have absolutely no idea what we're doing or what the consequences are going to be, and we won't have to pay for the consequences but maybe your kids or the kids after, some generation will pick up the bill.

And again, this gets back to what I would call the invisible present; we make a decision today

that has invisible cumulative effects into the future which we can't measure, and so it seemed to me the prudent thing to do is not do this over entire landscapes. I'm not saying we shouldn't experiment with it, but do it cautiously.

No. 4. As I said this morning, we deal with products not with the processes, and if we focus only on the products and we ignore the processes we end up losing the products because we destroy the systems that produce the products.

In Europe, for example, they have more nitrogen in the soil than they've had historically but the trees don't get it in some of the plantations because the mycorrhizal component, even if it is still there - and it is greatly depocreate now because of the acidity of the soil - the nitrogen translocation part of that fungal relationship evolved a nitrogen deficient systems, and so it took nitrogen out of the soil and moved it into the tree, there was also nitrogen-fixation going on inside the fungus.

Well now with more nitrogen than there was historically there, the fungus has shut down. It isn't that it isn't there, it isn't functioning the way it used to function because something has been introduced in a way, nitrogen, that the system did not

evolve to deal with it, so it altered the function of the fungi. These are the types of things that we need to be cognizant of.

5. As I pointed out this morning, the ecosystem is neutral, there are no value judgments in this. When we impose a value judgment we now have have no chance of seeing the system as it really functions, we see only the product or the end point that we would like to have. We need to learn to look at the system and say: What is necessary to keep this system healthy, and then on top of that, when the necessities of the system are taken care of, how much can we remove for our use without impairing the system's ability to function. That is a fair question, but I think we have to ask that question because population pressure is going to put more and more stress on these systems. And as we change the climate, and as air pollution takes over, we're having an impact on these systems and we're altering the variables across the board and we need to be aware of that.

6. Nature designed the systems to be flexible and timeless - this is the thing - and it's a continuum, it's an ever changing thing. We view the world, I think, in a product mode or linear mode.

We initially viewed it as a film loop,

but we saw a frame in that film loop we really liked so we cut it out, we tried to save it in a scrapbook where we're going to keep it the same forever.

At that point we've destroyed the film, we've made a film strip and, in this sense, we've altered the system again. And it isn't that we shouldn't do anything out there, the challenge we face is bringing our thinking in line with the way the system has been designed to function.

In fact, if we could do that, if we were to be open minded and have a beginner's mind, we'd have a lot more flexibility to manage the system than we do if we do it with these narrow constraints that we set for ourselves, because we actually become trapped in our constraints by law.

An example in the United States is, we have a law that says: You must have all acres reforested within five years in the west. You cannot log what you cannot reforest in five years.

In my opinion that's a dumb law. It was done because originally the timber companies were not reforesting, but what it means is there are a lot of acres that you couldn't log because they won't reforest in five years.

Now, having something in a shrub field

for 20 years or so might be very good for deer management or something else, it doesn't have to be a forest in five years, but we've spent an inordinate amount of money trying to reforest acres that are not ready to reforest and what has happened is they have justified cutting them on the basis of the assumption that they could be reforested, when ecologically we can look at them and know better, that they won't be.

So any time there's a blanket law or statement or concept like that, I think we put ourselves in a straight jacket and, to me, that is neither necessary nor wise. After all, the ecological system is really quite forgiving, provided we have the humility to learn from it and adapt with it.

Nature designed the forest of long-term trends and we're designing regulated economic short-term absolutes in plantations, that's because we tend to look at the profit margin rather than the processes of how the system functions.

Again, when you focus only on the product and you look at it from an economic view it says that anything that's left out there is an economic waste. And the way the Europeans envisioned it, the gentleman who came up with the rotation concept is, once the trees have gone beyond the maximum growth and the yield

slows down then they're carrying the investment further than they need to and they need to cut it so they can plant another forest.

Well, it doesn't work quite that way because Douglas-fir, for example, goes s-l-u-u-u-u-r-p to the nutrients as long as it's growing very fast. When the tree slows down is when it begins to have an excess and it puts things back into the system, but that's the very time that we cut it, and then we put in another young crop that were sucking those nutrients out very rapidly; we take out the organic material faster than it can be replaced or worked into the soil.

And the forest and the ecosystem changes over time and we have got to define these time scales, which I don't see anywhere, not just here but in the States or anywhere else.

The systems that we deal with have evolved over a very long period. And, for example, Douglas-fir has been the dominant in the forest for a short period, but that's 10,500 years. So in the west coast we're dealing with a very dynamic forest of which we really know very little.

We have to be cognizant of the time scales and we have to plan the present in terms of the future and project it out in a way to understand that

the longer you can look at a trend, the better chance you have of having some predictability in general of where this thing is going, because if you look at it in a very short piece that's like having a circle and you're looking at this much of it and if that's all you ever see, you can't tell what geometric shape that is, but if you look at this and you see it start to curve,, well now, you increase some of the possibilities.

If you looked at more of it you can see more of the possibilities, so you can get some idea of the trajectory of the system, but we're only looking at this much and then we're predicting everything else on this very short blink of an eye. That to me is not ecologically realistic.

8. Forests are designed to be self-sustaining, self-repairing. That again is the idea of the self-organizing system. It will take care of itself and it will change on some pattern, but it takes care of itself; just like my leg heals, you can't do it for me.

In trying to fix the system with herbicides, pesticides, fertilizer, whatever is used wherever it's used, that's a quick fix. We are impatient with the time scale that the ecosystem has set up. Now, we're back to time, we're stuck in our

time constraints. We invented the time constraints, and now we have become a prisoner of the time constraints.

In 1984 I took part -- I was part of the congressional committee framing the 1985 farm bill for the U.S. government, and the thing that stunned me, because I hadn't thought about it, was that soil erosion is no longer a No. 1 agricultural problem in the United States, it's pollution of the groundwater from fertilizers, from chemicals, and they didn't even take into account herbicides or denticides, fungicides, pesticides in general, but there was something like, I don't know, a hundred chemicals or so that -- elements, compounds that were in the groundwater that were not historically there.

And so I get -- in terms of the future, I get concerned when I see these chemicals or compounds being put in the ecosystem because we don't know what they do, we don't know the effect they have, and we don't know the cumulative impact over time, and this is something that I think we need to be very careful with.

The other thing is, if you have a system that is basically healthy producing things like the system that we harvested originally, I don't think you can do things economically much better, but they aren't

as fast and I think, when I look at all our technological gadgetry today, I think we have to ask ourselves when fast enough is fast enough, because we're really pushing the system.

Nature designed a forest with variable ages and some of them 500 years or more. We're trying to regulate the age because we're not looking at the forest now, we're looking at wood fiber as a product, and so we want to have something even that is predictable but, again, farming is not predictable, and in British Columbia I found that the name tree farm licence - which is what they call their timber licences - is very apt, because they're converting forests to tree farms as fast as they can. And that to me has all the pitfalls of farming in it.

And if we're going to farm a forest, we must accept the pitfalls of the farming, the same as a corn farmer accepts the pitfalls of the farming; the difference is they do it annually, we might do it over 80 or a hundred years, but the principles are the same.

Our coniferous forests, not yours up here perhaps, but our coniferous forests have a greater variety of species that live longer and have a greater variety or richer than anywhere else and what we are doing very often is selecting for one or two species,

but this has some dramatic impact on soil, for example, wildlife habitat, and how the systems function.

If we've got three trees - and, again, I'll pick a cedar - we happen to have western red cedar, hemlock and Douglas-fir - if they all occurred mixed on acres the cedar decomposes the slowest. It can be there for centuries, it's also a fairly basic wood, so it ameliorates the soil. The hemlock rots the fastest and is similar in acidity and Douglas- fir is probably the most acidic and is the second longest to decompose.

Now, if we select one of these trees we are beginning to alter the functioning of the soil because we have removed components, we've changed the basic acidity component, we've changed how things rot, so what we're doing now is, we're beginning to simplify the system and we thereby simplify the processes. We can lose mycorrhizae which are adapted to one species versus another.

If you look at the tree in terms of it's function as wildlife habitat, Douglas-fir in some respects is the most usable by non-game wildlife, but our big cedars get heart rot, there are big butt swells and they have big hollows that fisher, marten and bear hibernate in. They can't do that in Douglas-fir.

If you look at the cedar also, the bark comes off loosely, bats can get under it but birds can't nest in it, it's not good nesting habitat. And hemlock is essentially relatively useless as wildlife habitat in our part of the country.

So if you get rid of all of this other stuff for one species, you're again simply cutting down the functional diversity of the forest, and this is all having a tremendous impact over time and this is thje invisible present that we do not measure well and do not see.

Q. Now, during the Panel 6 scoping session the Board raised the following question, and that is: Can one still have plantations if you're attempting to practice ecologically sustainable forestry?

A. Yes, most definitely. That in a sense, done with prudence and done with humilit, is similar to what might come in after fire, the difference with the plantation, we're ordering it, and there's nothing wrong with that provided we give the system a chance to heal itself afterwards. You cannot have plantation and cut it, plantation and cut it, plantation and cut it, but you can have one plantation, maybe two, if you monitor the growth of the net primary

production or some other measure and then when it begins to slow down, simply allow that to go full cycle so it can repair itself. And in that sense the cyclic nature of the forest is simply recognizing that we aren't in control, but the system allows us to straighten it out in linear thinking for a little while without destroying it, and then allow it to cycle.

MR. MARTEL: Have we got any idea of how long that is in terms of time, and we can take it to the old growth forest, depending on the variety, but is there anyone who has attempted to tabulate what those rotation periods should really be? I'm not talking about the cutting rotation periods now, I'm talking about --

THE WITNESS: You're talking about the old growth recycling.

MR. MARTEL: Yes, the whole recycle. Has that anywhere been -- anyone attempted to try to put that in some context, species by species?

THE WITNESS: No, sir, I don't think so and I'm not sure you could do it species by species, I think you have to do it by forest type. But I think the more productive the system and the more careful we are to leave some biological capital recycle - which I think we will come to in a little bit - you can

probably have a shorter rotation than you would in a system which is maybe high elevation or way far north where the growth rate is very slow, the decomposition may be very slow so the cycling is very slow, that might take longer to do, but if we are even more careful with that, then it wouldn't take as long as it might otherwise.

The systems over time are very resilient, but in the short time, in the context of what humanity needs from it, that's where we can do the greatest damage. And so up front we need to build in a buffer, and I think in the northwest there have been -- well, I'm going to get ahead a little bit to try and answer your question a little bit more clearly.

There are two components we have to look at, it in an old growth forest there has been a continuity of the soil, regardless of what happened on stop. See, we tend to manage what we see above ground, and below ground is what I call our management unconscious, we don't really deal with that.

It's been very difficult to study, soil scientists are only now beginning to tackle it, but the build up in the continuity of the old growth forest going round and round and round in the soil over time is basically unbroken. If we take care of that soil so

that we don't disrupt that cycle too much, we can probably get by with shorter rotations in the resting stage, but to do that we have to leave snags and logs and other things out there which are the carry over component, which are the biological reinvestment. So if would front-end load the system some and manage the inputs, not just the outputs, I don't think we have to have them for tremendously long periods of time in all areas, one; and, two, we would space them over the landscape so they're simply built into the management plan as an ongoing process, not taken out of the allowable cut - or whatever you folks call it up here - and the other thing is, you always then have some first class quality product that can be harvested at some point, because you have the old growth not just the young fast growing trees.

I think that with some experimentation can be computed. One of the things that I think is very important to do - and your question is an extremely good one - is to set aside enough, which we will get into also later, to maintain some of the blueprint, but in other areas see about creating it, set up some long-term experiments so that some generation does get the answers from which they can make target corrections.

The arguments I have heard for years in court and out of court have been economically, we can't afford to save this, it's too valuable. My point is ecologically we can't afford not to the save it, and the argument is: Well, you can't prove scientifically that it's needed, and to me the burden of proof is on the liquidator because they have, to me, prove that it isn't needed for the future to have sustainability.

Now, if we don't have the answers now and we are going to cut it because we don't have the answers, to me that's a flatly ridiculous argument, but it is valid we don't have the answers, so how do we get them. We may not, but my question then becomes: How could we set up management so some generation can get them. So that if we do make mistakes, we at least make wiser mistakes than we might have in the past or that we might otherwise make and that some generation has ability or the chance or the option of making some target corrections.

MR. MARTEL: Well then, with large clearcuts if we don't know what's going on under the--

THE WITNESS: Right.

MR. MARTEL: --upper layer, as you say, do we really know the overall effects of massive clearcuts?

THE WITNESS: No, sir, we don't, because no one has ever done that and then lived through to see a complete cycle. We have cut the forests massively, but no one has lived to see the outcome. And what we do know from what they have learned in Europe is it takes about a century many times for the biological -- the cumulative biological effects to show up and then it's too late. It's sort of like rabies, when you get the disease, when you get the symptoms, you're already dead.

And ecologically we're not killing the system, but we may shift it in a way that it loses a tremendous amount of productivity over time, and if population continues to grow, I don't think the future can afford that.

The only thing - to finish up the thought for you - the only thing that I know of that we have to offer the future is options, choices and if we do not, as part of our management, safeguard those options, if that is not the final aim of management is to pass forward the options to the next generation, my feeling is we have not only been derelict as human beings, but we have also probably set a course in the ecosystem that may be very detrimental to them in the future as the climate and other things become less stable than

they are today.

MR. LINDGREN: Q. On the issue of regeneration, Mr. Maser, do you have any views or preferences concerning artificial regeneration versus natural regeneration techniques?

A. I would suggest that natural regeneration is by far the best because you can in fact manage a native forest by managing the native gene pool, and with the impending global warming, having the greatest genetic resilience gives us and the future the best insurance policy to have adaptable forests in the future.

Global warming is going to cause the forests to have to go through some real gyrations and shifts, and just because a species is spread across the landscape doesn't mean that the individuals or the groups of individuals are uniformly adapted across the landscape, because they're not.

There's a study come out, I was reading on the plane, about sugar maple for example, that in the southern part of its range in the United States it has one form, it's got fairly thick long leaves, in the northern part of its distribution the leaves are very thin, and they come on at tremendous volume at very little cost to the plant and it does not produce the

same amount of sugar. Well, if the global warming comes on the way it is predicted, then the climates we have in Texas could end up within a century in North Dakota and forests simply cannot migrate that fast.

So the greater the genetic resilience built into the species as a whole across its geographical distribution and maintained the better chance we will have to do something with it because, we must remember, we don't know in a forest which species will be able to adapt and within which species which individuals.

It's no different than a group of people in the United States. We all look like human beings, but genetically we are a tremendous mix. And so -- or you can take it in terms of jobs might be a little bit better way to look at it. We have a tremendous variety of services we can perform, but if we start plucking out services to streamline the human being and to specialize ourselves and there's sudden change, then we run into problems if we don't have somebody to perform that function. Genetics is the same thing, that's the ultimate functional part of adaptability in the system, and if we remove too much of that we may find out that we've removed the wrong pieces.

Q. And is that why you prefer natural

regeneration over artificial regeneration?

A. Yes. That is the best way to maintain that native adaptable genetic mix.

Q. Okay, thank you. I understand that you would like to show some slides to the Board in order to explain nature's blueprint for a forest. And before you do that, I just have one question for you.

None of your slides were taken in Ontario. Can you please indicate whether the ecological principles and processes depicted in the slides have any relevance for this jurisdiction?

A. The ecological principles and concepts are applicable throughout the temperate coniferous forests, whether it's Europe, here or Sweden, that doesn't make the difference. The species may be different, they may function a little differently, but the principles and processes are the same.

When we were working with the mycorrhizal component, our first paper, study came out in 1978, since then the same relationships, we've been able to document it in Argentina, it's been documented in the Pyrenees on the border between France and Spain, it's been documented in Germany and they've even found that that small wallabies, the little kangaroos in Australia

perform the same type of function in the Eucalyptus forests.

So we find that again redundancy, that principles and concepts are very broad, species tend to be much more limited.

Q. okay.

MR. LINDGREN: Madam Chair, this is slide No. 1.

THE WITNESS: What I'm going to go through is basically an old growth forest, and the reason that I'm going to pick the old growth forest is that is the stage in our forest that is in the most limited supply. It's also the area in which we have the entire genetic code in tact and we have all of the processes functioning.

I'm going to show you our understanding of how a rotting tree functions above and below ground, and please keep in mind, this is a very, very simplistic view because we're just beginning to understand what we think is going on and we're never really sure of that.

Trees come down in our forest usually one of two ways. In this case, the tree is blown over by the wind and got caught; the other way is to die standing as a snag, in which now the processes begin to

change and then it gradually falls.

MR. LINDGREN: Q. And we're looking at slide No. 2 here.

A. The point I would like to make with this is that the trees - I hear the term mature and overmature, those are economic terms, they have nothing whatever to do with the life of a tree. Trees potentially, not factually, but potentially are immortal because they replace their entire living tissue every year and their entire immune system.

What kills trees is not old age, it's injuries and disease, injures allow disease to enter, which may have happened here for example. Trees become injured and it might take them a century to die. We can sometimes determine what has killed them, but we don't know when they contracted whatever it is and what caused it.

Q. This is No. 3.

A. Ultimately the trees come down. Now, the log on the bottom was a healthy tree that got blown over by the wind, or at least it wasn't caught, it wasn't dead and rotting or declining. This was a snag that got blown down.

The obvious thing in this slide is that the two trees, one lying on top of the other, create

vertical diversity, habitat diversity, but that is the only the beginning and the obvious part.

Q. This is No. 4.

A. When a tree falls, within that first year, the bark beetles enter it. This beetle happens to be an ambrosia beetle, it's so-called because there are small structures in it called mycangia and those mycangia carry the spores of fungi in them.

Now, this little bark beetle does not feed in the cambium the way most of the bark beetles do, the cambium was that living tissue just underneath the bark. That generally is eaten first because it's the highest in protein.

This beetle is a sapwood feeder, which is the next most important and nutritious part of the wood, it is very high in carbohydrates. But this particular beetle does not even eat the wood, it chews his galleries in the wood, lays its eggs, and the adults of the larva feed on the ambrosia fungus that the beetle carried into the wood that germinates.

One thing that we learned in a 200-year log study that is set up on the H. D. Andrews experimental forest, is that these beetles when they enter and they would enter a log that goes about from that table to this bench, there would be about 4,000

pairs get into that log within the first year, they're very small, but they introduce nitrogen-fixing bacteria at the same time, which means primary nitrogen-fixation takes place.

What that means is, is that the bacteria have the capacity to reach up into the atmosphere and pluck out the nitrogen gas internalize it and change it to a component that is usable by other organisms.

So the beetles not only feed on the fungus but they also start nitrogen-fixation, start building up nitrogen in the deadwood.

Now, the fungus, if the wood is too dry, does not fruit well and the beetles starve; if the wood is too wet, the fungus explodes and the beetles smother in their own food supply.

Q. No. 5.

A. The next general group that comes in are the metallic or flat-headed wood borers. They tend to be sapwood feeders as a whole, but some actually feed on flowers, but some feed in cambium and some also in heart wood. Now, in the wood we have a prey base built up.

Q. No. 6.

A. And the third one that comes in is the red predator group, like the red-bellied checker

beetle. It feeds on the eggs and larva of the first two. So now there is a predator/prey relationship built up in the system.

Q. No. 7.

A. As the wood continues to decompose and get wet the mites enter. This mite is called an oribatid, it feeds on decaying vegetation, but the mites do a little bit of everything as a whole. As a group this one is a specialist on dead vegetation, there's another group that are predators, there's another group that grazes on fungi, there's another group that grazes on the bacteria, there's another group that eats just the droppings of other animals, and there's a group that actually eats wood.

To inoculate their system with the appropriate little micro-organisms, the protozoan, which is a one-celled animal, and the bacteria, they feed on the droppings of the beetles in their galleries. That inoculates their system and then the mites can themselves eat the wood.

Q. No. 8.

A. Next come small groups of insects like the springtail. The springtail is so-called because this little appendage back over here, which is called the furculum is normally folded up underneath

the belly and if you were to touch this insect back here it depresses that very rapidly and it catapults the insect forward. A lot of cross-country skiers know these as snow fleas.

This little insect feeds primarily on either bacteria, it grazes bacteria or it feeds on the strands, the little gossamer threads of fungi.

Q. No. 9.

A. Another group that gets in at the right time is the carpenter ant. Now, this one to us is a critical species, particularly east of our Cascade Mountains because the carpenter ant colonies are in large wood. And this is a log, this has been cut. We are making the large snags, large logs, they are a finite resource because we are looking mainly at the old growth forest. They are renewable, but only if we regrow the big trees.

If we never plan to regrow old growth on long rotations, the large snags, large stumps and large logs are gone, period, and that will have a dramatic impact on the functioning of the forest.

But for the moment we'll look at the carpenter ants and they are called carpenter ants because they chew out their colonies in the wood but they do not eat the wood, they spit it out. They live

in the logging debris up to a point, but this does not last in the state very long that is compatible with carpenter ants, so their main viable colonies are in the dead parts of live old growth trees.

These ants are critical to our forests. One, they are the main diet of the pileated woodpecker in our part of the country - they may not be out here - but the other thing is, the carpenter ant we've discovered through some of the Forest Service researchers is one of the main predators of the western spruce budworm in the west.

And the way this works is really rather intriguing. Carpenter ants have two basic food habits. There's a group that feeds on the honeydew produced by aphids, which is the aphid's waste product in essence, it's the sticky part of the sap, an excess that they suck out of the plants, and the ants actually herd them around.

They take the aphid eggs in the fall into their colonies, protect them over winter, and in spring when they hatch they put the little aphids out on to spring pasture, as it were, and then herd them the way we might livestock.

The other group of carpenter ants are predators and scavengers. Now, as we cut the old

growth forests and as we change the way it is structured, we're having an impact on the kinds of birds that can live in the forest. And we found there are two groups of predators that help to control the western spruce budworm - they also do the Douglas-fir tussock moth, but the budworm is a slightly better example - that is a group of birds called the feeding guild that feeds specifically on the larva and the pupa of the budworm and in carpenter ants.

But what the scientists discovered was they knew the birds were feeding on them, so to find out the effect, they built big chicken wire cages and put them over whole live trees, and they found that 80 per cent of the western spruce budworm was still disappearing. Now, they couldn't figure out why, what was getting it.

So finally after several months of scratching our heads, we put sticky foot, tangle foot - it's a sticky substance around the base of the tree to keep the ants out - a hundred per cent survival where there were no birds and no ants. Where the birds were kept out and the ants were allowed in, they could control roughly 80 per cent of the western spruce budworm when it's in its normal background levels.

Where we put sticky foot around the trees

it kept the ants off but the birds were allowed to enter, they found that there was 80 per cent removal again. So between the two, the ecosystem is balanced now with these insect outbreaks, which are a normal part of the cycle.

The thing that created most of our outbreaks is fire suppression, which has stressed the system and the tree competition to the point that we have a lot of stagnant stands and most of the insect competitors hit trees we found which are not healthy, they're not vigorous - that's the word I'm looking for.

So if we lose the habitat for the carpenter ants, let's say we change the forest for birds, we still have a component in there which is helping to control the western spruce budworm, but if we eliminate this also, we can set our managed stands, as it were, up for just as munchies for the insects with no -- there's no habitat diversity to break up the continuity of the insects, we give them a smorgasbord and we've removed the basic controls.

So one of the things they did was spray DDT, the Forest Service did when I was working in northeastern Oregon, and we looked at bats. I was concerned about that because DDT is a fat soluble substance. You see, they didn't want to do this, they

wanted to get out the product, so they sprayed the forest, and we found when we looked at the bats that the California miotus - I'm not sure it gets up here - but it had about 14,000 times more DDE in it, which is the metabolite what DDT breaks down to than the other species because it feeds on aquatic insects and the aquatic insects, the midges were concentrating the DDT in the stream water.

We also found that DDT is passed to the young of the year through the mother's milk. And since bats hibernate, they absorb the DDT in their fat and it doesn't kill them initially. This is the invisible present, but during hibernation they can die because then they metabolize the fat, and can be a lethal dose.

And then we found something very interesting, the United States no longer allows DDT but we export it, and we had a bat come up -- one of the bats we worked with was a migrant coming up from Mexico and it was contaminated, because we sold it across the border.

This is why I'm saying that what you do to forests in Ontario, what we do to forests in the United States today affects everyone.

Q. No. 10.

A. And then there are organisms like

millipedes which feed on decaying vegetation. Now, this particular millipede is in what is called a molting chamber and I always think of this when I think about the struggles we have to change our thinking. an insect or an arthropod like this one, has a stuff exterior called an exoskeleton, an outside skeleton, and it becomes hard and the insect can only grow when it is soft, and then as that outside skeleton hardens, the insect can no longer grow. So during the molt they're very vulnerable, but that's also when they're doing all the growing they're going to do before that outside skeleton hardens.

And that is like our thinking. We start out with new ideas, a new thought process, a new paradigm in forestry and it's risky, and that's where the old forestry came from, which today I referred to as plantation management. It was right in its time and place, but the thinking has become rigid and it no longer can absorb new data in here because new data disturbs the old thought process, the old paradigm. So this has to be cracked so that new thought processes and a new paradigm can evolve which better fits the knowledge we have today, but we must also understand that that paradigm will grow old and must also be cracked at some point in the future. This must be an

ongoing process.

Q. No. 11.

A. Then there are the large round-headed wood borers, this one is called arigaties, it lives in the heart wood primarily which is not very nutritious, so the larva take from 3 to 7 years to mature, but they leave behind a burrow that's about an inch in diameter and that is secondarily used by salamanders.

Q. No. 12.

A. And then we have termites. We have the dampwood termite, and the termite is where the forest starts to get complicated. When you look at a termite you see the obvious insect, and this is why I say over and over and over in science we can only understand the appearances - and that's all we can understand in management - because what you see here is really three organisms in one, each appended on the other.

Termites in the fall gather at the entrance of their colonies and within about one half hour before flight time - this is the winged form - they all mature sexually and they take off on what we call their nuptial flight. When they select their mates, they land on the ground and they walk to wood, usually large logs which are ripe for them to inhabit,

and they determine this by the odours given off by the fungi that are decomposing the wood.

Once they have found the wood that is right for the them, they break off their wings, they go into the wood and they chew out their nuptial chamber. From there the female is mated and it starts laying eggs, and the larva then mature and start chewing up the colony.

The termite has very, very powerful mandibles or jaws, as you can see up here, and they eat the wood. The wood that they eat is about 70 per cent infected with decomposition fungi, so it's soft, but the termite still cannot digest the wood, it depends for digestion on a one-celled animal, the protozoan, that has the appropriate enzyme called cellulase to digest the cellulose that is in the plant cell walls that gives them rigidity.

Here the challenge is that the protozoan requires a constant supply of nitrogen in order to be able to perform its function. Nature has endowed the termite with the protozoan with the one-celled plant, the bacterium, which is a nitrogen-fixer. It can take nitrogen out of the atmosphere.

So the termite eats the wood, it passes to its gut, the protozoan digests the wood, the wood

that the termite eats we now know does not have a constant supply of nitrogen, so the nitrogen-fixing bacterium must keep that supply constant.

And it's sort of like the burner in a hot air balloon. When nitrogen is deficient the bacterium turns on; when it is sufficient, the bacterium turns off. Between the bacteria and the protozoa is a fermentation process that produces acidic acid. The acidic soaks through the wall, the gut wall of the termite and fuels the termite.

This as an obligatory symbiotic relationship, it's the proverbial marriage made in heaven; they have to have each other, if something happens to the one, it happens to the all. And this is the way our forest functions, in miniature.

Q. No. 13.

A. Then there are small organisms like pseudoscorpions that feed on the other small organisms, this is one of the predators.

Q. No. 14.

A. And finally there is the Pacific folding-door spider. That and centipedes are the top of the invertebrate predator line, they have very strong poison claws.

Q. No. 15.

A. Also in the forest are things called sowbugs. I put these in because they are very important as food for the salamanders that we have - I don't know if you have them here - but they are in the Mexican mountains also that feed on -- that live in the food.

Q. No. 16.

A. I'm going to, if you don't mind -- will my carousel work in here, these are all jumbled up. I'm sorry, they're all mixed up, they're not right side up. That's upside down and that isn't very conducive to human --

MR. LINDGREN: Well, we can take a break --

THE WITNESS: If you don't mind things being all jumbled around, but I don't know the rest of it, that's why I brought mine.

MR. LINDGREN: Okay. Perhaps, Madam Chair, we can take a break for a moment to allow Mr. Maser to put in his carousel of slides.

MADAM CHAIR: Certainly. Go ahead, Mr. Maser.

---Short recess

THE WITNESS: We have four salamanders that are in the family plicadontidea - which means

lung-less salamander, they in fact do not have lungs - that live in the wood. Now, you may not have salamanders but the principle the salamander demonstrates is applicable here for other organisms.

The salamanders absorb their oxygen through a moist skin and the large logs under a canopy, whether it is young forest or an old growth forest, becomes saturated with water and they hold that water year round. So this in a sense is an aquatic habitat for the salamanders.

They require that in our part of the country two times out of the year, once in the spring when they lay their eggs because even though they are amphibians they lay very large eggs and they lay them in the wet wood and the larva goes through its aquatic stage inside the egg. The second time is during the drought of the summer when the forest dries up, in fact it becomes like tinder which is when we have our forest fires, and the salamanders find refuge in the large wood.

The other thing about the large wood which you might note in Ontario, as we have in Oregon, when there is a forest fire the wood that was under the canopy is wet enough to survive and we have found the wet wood, still wet after the fire, to be refugia for

some of the microorganisms which are needed to reinoculate the sites. So if these large wet logs are buried or lying on the surface, when fire goes through many of them retain the living component inside the wood and that is very important to reinoculating the system.

Q. No. 17.

A. Now, we come to the fungi. Fungi are exceedingly important in the forest because they basically drive the system.

Q. No. 18.

A. Let's go to the wood for a moment. Residence time on the bottom there means the length of time that the wood lies on the ground decomposing. In Oregon that is a very long time on the western slope of the Cascades where it's wet.

We may have a 400 or 500-year-old tree take five or 600 years to decompose and recycle into the soil. So if you have, let's say, a 400-year-old tree that lasts on the ground 400 years, that one plant is influencing that one site for 800 years. This is a very long time.

Q. What does Class 1, Class 2, Class 3 represent?

A. I will come to that in just a second.

Q. Okay.

A. Wood density here on the side is, as the wood rots it loses density, that means it becomes spongy and so it absorbs moisture very readily. Log class was a physical system of characterizing the rotting wood that we devised when we first started studying the large logs to give ourselves a way of understanding what it was we were talking about. Ecologically it's probably nonsense, but for us we had to be able to communicate somehow.

A Class 1 log is a tree which has just blown over, it has the needles, it's got the twigs, the bark is in tact. A Class 2, the needles and twigs are gone, the large limbs are there and the bark may be starting to loosen. Class 3, generally the bark is gone and the sapwood is being utilized by organisms, and between Class 3 and Class 4 there is a dramatic shift and this is one of the more important parts we discovered.

Between Class 3 and 4 the sapwood sloughs off, it simply fragments and falls off, and what is left is the heart wood. The heart wood is primarily lignin and in the lignin is a substance called vanillic acid; that is absolutely critical to the forest in the formation of humus, which in turn is critical in the

formation of mycorrhizae. This is the longest lasting component and that's why the large, old growth trees are important; the larger the tree the greater the mass of the heart wood.

Heart wood in this case would be lying on the surface, down here it would be buried and slowly incorporating into the forest floor, but in terms of nutrient cycling in the system, this is the most important part of that fallen tree, and we will lose that as we lose the old growth carry over component unless we plan at some stage, over the landscape, over time, to replace it.

Q. No. 19.

A. We have made a lot of mistakes in science because we too had linear thinking and blinders on. I think that is an occupational hazard of western civilization.

We looked at logs and for years we argued for structural diversity, not understanding functional diversity. If you look at this, here are some different types of decomposition. Here are the beetle galleries. This is white pocket rot, this in our forest turns out to be absolutely critical because what it does is separate the annual rings between the spring wood and the summer wood, and in our forest the western

hemlock grows on top of those trees, so does Szitcus spruce, so does Ingleman spruce and, in Europe, Norway spruce is adapted to grow on rooting wood.

The hemlock root tips go down in the white pocket rot because they can separate the annual rings and those roots will grow the entire length of the tree. Without white pocket rot, our hemlock seedlings would be hard pressed to survive and grow to hemlock trees in the native forest because hemlock is is the climax tree. Douglas-fir for us is a fire subclimax, and the duff layer underneath the Douglas-fir becomes so thick that hemlock seedlings cannot get their root tips down to mineral soil before summer drought and so there's an extremely high mortality, except for what we call nurse logs.

Q. No. 20.

A. The fungi I'm going to talk about are called ectomycorrhizal fungi. Ecto meaning outside, myco meaning fungus, rrhiza meaning root. These data are from the Rocky Mountains in Montana in a dry site just to demonstrate that 66 per cent of this marriage, the mycorrhizae is an obligatory symbiotic relationship between the tips of -- tree roots, the root tips, the feeder roots and the fungus, they have to have each other, neither survives without the other.

66 per cent of that marriage takes place in humus, 21 per cent in decaying wood specifically, there are mycorrhizae that are specifically decaying wood specialists, 8 per cent with charcoal. Notice that if we get rid of the wood component from the soil we remove 95 per cent of the mycorrhizal component with root tips.

This is what has happened over much of southern Europe. In 1985 I looked at soil pits in the Bavarian forest that were five feet deep, they have not had wood in their soils for over a century. They have removed it all. It's called intensive utilization.

That has had a dramatic impact on the health of the belowground system because while the elements like phosphorus and potassium and sodium are there in abundance, this organism, this marriage between the fungus and the tree root; the fungus is the uptake mechanism, so without fungus - and you don't have the fungus without organic material in the soil - without that, the elements may be there in an abundant supply but the tree cannot access them.

MR. MARTEL: Well then, full-tree -- what happens then in full-tree harvesting where you take everything basically?

THE WITNESS: There is a dramatic impact

on the nutrient capital that is returned to the soil. It puts the forest in a deficit budget unnecessarily.

The primary nutrients that would go back into the soil are from the crown and the limbs, not from the trunk. Taking out the trunk does not have nearly the ecological impact that taking out the whole tree does. The other thing is, you're pulling out the roots too, or are you just cutting it off at the top?

MR. MARTEL: We cut off the top.

THE WITNESS: Because the root systems are extremely important also, and in some places they actually take them out.

The impact of whole-tree harvest as we call it, or full-tree harvest is dramatic. The reason that the trunks or the stems are important is for the other part of the system I'm going to, that is a much slower release of nutrients into the system, but the crowns and the limbs have, I would say - and this is a guess off the top of my head - but I would say roughly 80 per cent of the nutrients that are in the tree are in the limbs and the needles. So if you take that out too, you have taken out a tremendous amount.

Q. We're now looking at No. 21.

A. This white thing around the root tip here is the mycorrhizal fungus, we call it a fungal

mantle. This happens to be large-pole pine.

Now, you will notice that some of the root tips are not inoculated, like this one here, you will notice there is no little white dot at the end, this one has just been inoculated. These root tips will not survive unless they are inoculated, they shrivel.

What you don't see here is the billions of miles of gossamer threads going out into the forest that I will show you in a moment.

This root tip has been inoculated. What this does is stimulate root tip production and it protects the root tips from pathogens. The pathogenic or disease-causing fungi are out here in the soil. These fungi form a hormonal barrier which is a no-fungus zone which protects the root tips and, therefore, prolongs their life. To the tree this is critical because there's a very high turnover in terms of energy with the renewal of the root tips every year, to the extent that the fungus maintains and prolongs the health and life of the root tips, to that extent the tree can put on radial growth in wood fiber, it is not putting all of the energy it would put belowground. The tree puts a tremendous amount of its energy into maintaining this belowground system.

Now, from here--

Q. No. 22.

A. --the hyphae or mycenia go out into the soil and form what we call hyphal mats. And if you could separate these strands, they're about one cell thick, there are billions upon billions of miles of these gossamer threads and they act as an extension of the tree's root system in the soil.

The tree cannot get sufficient water, phosphorus, nitrogen, et cetera, on its own. We have been able to keep trees, conifers alive in the greenhouse under conditions of no stress, but we have found that the first sign of water stress without mycorrhizae the tree dies.

So this is an extension of the tree's root system, that is why it is absolutely critical to the survival of the tree. It takes the nutrients and moves it into the tree's root tip and it then goes up into the crown.

Q. No. 23.

A. What it looks like -- this is a hyphal mat that picks up the water, phosphorus, nitrogen and other metabolites, other goodies, moves it into the feeder hyphae which take it to the roots of the tree through the root tips and it goes up into the

crown.

The tree in turn sends down sugars from photosynthesis that goes out through this fungal system and feeds the fungus. So like the termite, we have one organism feeding another organism in a mutualistic relationship which is obligatory to their survival.

Q. No. 24.

A. There are two kinds of fungi that do this. Mushrooms, like this bolitus where the spores come out through these little pores, and gilled fungi--

Q. No. 25.

A. --like this one where the spores come out through the gills.

We found some interesting things with this. In our forests in the northwest the mushroom is not so important as the truffle - which I will show you in a moment - because these spores are dispersed by the wind. The spores come out here and they have to blow through the forest on the air current. They land on the forest soil and then they have to be washed in with rain water, and that means they have to percolate down through the soil and come in contact with roots that can be inoculated.

You will notice here that there's a large log and here's a Douglas-fir cone. In our forests and

in any area where you have forests that form dense thickets at some stage, the mushroom does not do so well in inoculating the forest, because if you go into these dense stands and you get close to the ground there is almost no wind. The higher up off the ground you get, the greater the wind velocity. This is where deer and elk go for what we call thermal cover, they get out of the influence of the wind in the interior of stands.

So the mushroom is not very effective there, it is effective after fires, it is effective in clearcuts, it is effective in mixed forests like you might have here in the southern part of the province and like in New York, but it is not so effective in the very dense stands, and as you get further north where it's very dry and/or very cold, a dry cold year will cause the mushrooms not to fruit, and any mushroom picker knows that.

MR. LINDGREN: Mr. Maser, before we continue, perhaps this might be an appropriate time for the afternoon break, Madam Chair.

MADAM CHAIR: Are you ready for a break?

THE WITNESS: It's a good place to stop, sure.

MADAM CHAIR: All right. The Board will

return in 20 minutes. And before we break, I have a note here from Mr. Pascoe that the Affidavits for Service from the notices in Exhibit 1673 included Timmins, Hearst and Geraldton.

Thank you.

---Recess taken at 2:40 p.m.

---On resuming at 3:00 p.m

MR. LINDGREN: I believe, Madam Chair, we are looking at photograph 26.

THE WITNESS: Just to bring you up to date, the last pictures we looked at were the mushrooms. These will be called truffles.

The mushrooms are called epigeous fungi, they fruit above ground, these are hecogeous, heco meaning they fruit belowground.

And you will notice the cracks in the soil here. That is where the fruiting body is, just below the surface and that's what they look like. Most people know about truffles because they are used to flavour food.

MR. LINDGREN: Q. This is No. 27 and we're now on No. 28.

A. Unlike the mushroom the truffle has no way, no natural dispersal mechanism to get its spores scattered around. This tough outer coat is

impervious to water. This is the spore-bearing tissue in the centre and actually this is in the soil, so this should be turned around the other way. This is the outside of it. The spores are in here.

Without having evolved the mechanism of being eaten by small mammals, large mammals like elk and deer and bear and insects as well, these fungi can only get their spores dispersed by rotting, they disintegrate in place and the spores must wash through the ground water. That is a very cumbersome system.

So the fungi having evolved, co-evolved with primarily small mammals, things like the southern red-backed vole which you have in Ontario, the northern flying squirrel, which you have in Ontario, the deer mouse or the white-footed mouse which you also have in Ontario, they feed on the spores and then disperse the fungi. And I will come back to that.

Q. No. 29.

A. These fungi come in a variety of sizes and shapes in terms of their fruiting bodies.

Q. No. 30. No. 31.

A. The point is, however, that this whole system is belowground. You saw the mantles around the root tips, you saw the hyphae go out into the soil and form the hyphal mats where they pick up

the nutrients, move it into the tree's root which is right here, through the feeder hyphae, up into the tree and the tree feeds the fungus sugars from photosynthesis.

When the temperature and moisture conditions are right, a fruiting body is formed totally belowground. So this whole system is out of site. That is very important in those areas where there are either cold snaps, dry snaps, or very dense forests because this system does not depend on wind or the above ground weather to be dispersed, it depends on being eaten by small rodents primarily.

Q. No. 31.

A. Let's go back to the wood for a moment. As the wood lies on the ground rotting, the residence time, it increases in moisture, water. You will notice this is a live tree right here and by the time it is all heart wood it is 200 per cent of the moisture that it was originally. At this point it remains saturated.

This is buried now and beginning to break down belowground. This is a totally saturated log which is just heart wood. Under a canopy, be it old growth or young growth, that remains a water reservoir throughout the summer, throughout the year.

Q. No. 33.

A. Here is a round, a wafer we call it, that we cut out. You will notice the different kinds of decomposition. So this is functional diversity in here, these cause the wood to rot differently and this wet spot is metabolic water, as we call it, it's produced by the decomposition of the wood through bacterial action primarily.

Q. No. 34.

A. This is heart wood of a large tree that's all that's left of it is totally saturated. I can take my arm and push it in here almost up to my elbow it is so smushy, grab a hand-full of wood and pull it out and squeeze the water out of it. You will notice that it's dark down here, that is where it has the greatest saturation, and this was taken I might add in July on an exceedingly hot year.

Now, there are some things I would like you to notice about this. Notice the slope, how gentle that slope is, but look at all of the soil and organic material that is held in place on the upslope side.

This on slopes prevents what we call soil creep, it prevents erosion. When this large woody material is left in place going along the contour, it helps hold the soil in place.

If you look at the downslope side, right here, below the log you will notice there is an open triangle. This open triangle is the protective covering that the small mammals have available as habitat to prevent them from being eaten by owls, and this is where they travel in their normal activity, and that is also where they disperse most of the mycorrhizal spores in their little pooparoonies.

This is the most dynamic portion of the system right here in terms of nutrient exchange with wood, and we know virtually nothing about it. There has been a 200-year long log study instituted in the H. J. Andrews experimental forest that is now -- this study was set up for the generations of the future, starting a few years ago, and it is funded to be completed 200 years from now so some generation has the answers we struggle with today.

Q. No. 35.

A. This particular fungus, to show you how some of these things become adapted, is called rhizopogon vinicolor - I'm sorry it has no common name - it is a truffle and it is specifically adapted to the roots of Douglas-fir, it occurs with no other tree and it is a rotten wood specialist.

This is very important, because this is a

Douglas-fir root and here is the mycorrhizae which is the marriage between the fungi and the root of the Douglas-fir forming what we call tuberculite mycorrhizae with little structures that we call rhizomorphs.

The rhyzomorph you might think of as a siphon that's very adept that taking water out of wood. This is a rotten wood specialist. That fungus goes into the wood with the root tips of the fir and it extracts the water from that wood reservoir and takes it into the Douglas-fir.

In our forest during the summer that is important because as the summer drought continues the mycorrhizae in the root tips that are near the soil shrivel up and the forests -- our forests shut down. I don't know when your forests put on most of their -- produce most of their photosynthesis, ours does it during the winter. So during the summer they close down, they close the little openings in the leaves, the stomates to prevent the loss of water, but they continue to grow where the water is available from the logs through the fungus.

We have also found that seedlings that are planted in clearcuts that have this associate on their root tips are twice as drought resistant as those

that don't have it. So just because you inoculate seedlings in a nursery and outplant them doesn't mean that they're going to survive.

We have found whole plantations that are dead and at first we blamed it on animal damage and we pulled them up and looked at them and discovered that the trees were non-mycorrhizal in the sense that the fungus that was in the nursery was not adapted to the site.

And so just as people think of seed zones, they know the trees are adapted to, let's say, certain elevations, we're beginning to understand that a lot of the fungi are similarly adapted and we're beginning to think that there is some genetic compatibility between the site-adapted fungi and the site-adapted tree. It's much more specific than we have heretofore thought.

Let's go back to the wood for a moment.

Q. Sorry, to interrupt. We are now looking at No. 37.

A. Residence time again is the length of time that the wood is lying on the ground and this is the curve for nitrogen input into the rotting wood. A phosphorus curve is somewhat similar. This is an older slide but the point is still there, it increases in

nutrients as it lies on the ground.

The nutrients come in in several ways. In an old growth forest the rain water or the snowmelt that comes through the canopy brings a lot of nutrients with it from the lichens that grow in the tree tops. We call them epiphytes. A lichen is another mutualistic plant, the fungus forms the body outside and the colour is given by algae that live inside the fungus body, together the algae produces the photosynthesis that feeds the fungus and the fungus houses the algae.

Some of these algae, the blue-green algae, can fix nitrogen, and so as they decompose and break down in the tree tops and water comes through, there is a nitrogen input into the wood simply by the water soaking in and the nitrogen then accumulates.

Organisms die in the wood and roots penetrate the wood in the fungi, and when they die in the log, whatever elements they have in their bodies are trapped, and then there's nitrogen-fixation introduced by the beetles. So this makes an idealic state.

Q. No. 38.

A. Let's recap for a moment. A big tree falls over and there's a large log on the ground and,

let's say, it's there -- it starts to break down, within the first year the cambium tends to go very rapidly, then the sapwood. While the organisms are decomposing inside, the fungi, the insects are eating it up, it opens it up with lots of little tunnels and checks and cracks. This allows the plant and animal community inside the wood to explode, not only in numbers but in kinds.

Now, we have determined that a tree like this which is on the ground, when the sapwood is occupied to its maximum, has twice the living biomass of cells that the live tree had. So ecologically this is more alive than the lilve tree.

As it decomposes and the sapwood sloughs off and becomes heart wood it begins to serve a different function, it becomes very simple, and the only things that we know to date that can break down the lignin and release the vanillic acid which is the organisms in use as a carbon source or food, are the fungi and the bacteria.

Now, while all of this is going on inside inside, internal succession if you will, the outside community is growing up around the log and beginning to protect it from sunlight and wind and allowing it to remain -- to retain more of its moisture. So an

external succession goes on simultaneously, the forest grows up and the log sinks into the soil.

What that does is take the old part of the forest, of the old forest in the wood and it recycles it into the soil to be used by the next forest. This is biological capital that is being reinvested. We cannot invest biological capital per se we cannot -- we can divest it, we cannot invest it, we can only reinvest it by leaving it out there.

If you make an economic reinvestment in something what you do is make the money first by selling products or whatever, then you take a portion of that capital and you put it back into the maintenance of the business, that's an economic reinvestment. We cannot do that in a forest because the forest does not run on money, we cannot fix the pieces.

So biological capital is reinvested by not harvesting it, by leaving a portion out there to recycle to maintain the health of the soil.

MADAM CHAIR: Excuse me, Mr. Maser.

THE WITNESS: Yes?

MADAM CHAIR: One question that we put to your counsel for your consideration during the scoping session was whether leaving slash on the site

substitutes in a way as being a type of biological reinvestment as opposed to waiting for old trees to fall down and decompose.

THE WITNESS: Right. There are a number of ways of doing that and slash can do it up to a point. The fine tops, as we spoke about before, yes, when they're scattered over the landscape, but if they're windrowed, if they're piled or put in rows that is exceedingly detrimental, it does nothing for the all over area for one thing; and, two, one of the big problems we're finding is soil compaction and any unnecessary activity in terms of large equipment that compacts the soil has a tremendous impact on these processes belowground and we are only now beginning to ask those questions.

So I would suggest that windrowing is exceedingly dangerous over time and so is piling especially windrowing and or piling and burning.

Slash in British Columbia is this high, I mean, you can fall off it and really injure yourself because they simply cut the forest and left -- I have never seen anything like it in my life anywhere I have ever been.

Now, you can say that it's not biological waste, and that's true, but bear in mind that if you

plan never to grow these big trees again that is a one-time shot in the arm for the forest. What do you do after that? That's is the concern I've got.

I'm not concerned with now, leaving slash is cheap, it costs nothing, but what about the next rotation and the rotation after that. That's the critical part.

That means we have to actually leave some biological reinvestment at some cost, no different than running a mill, no different than maintaining a logging operation, we must consciously leave some there. That we are not planning to do that I'm aware of anywhere. We are starting to do it in the States, but there has been a tremendous hassle over it and it isn't that anyone looks at this with mallace or looks at it in a skewed way, it's simply that new ideas take a long time to catch on and as we learn more, we simply have to change.

Leaving slash, I would say, is good depending on how it's left and where it's left and that doesn't mean that you can't have fire breaks in it, it doesn't mean that you can't do a variety of things. We actually have some sales in the States these days where the contractors actually, if they don't have enough wood along the contour, they are placing the logs. We

also have sales which we call shelterwoods. Are you familiar with that?

MADAM CHAIR: Yes.

THE WITNESS: In which the overstorey is not going to be cut, that is the reason that they cut the initial 80 per cent, the last 20 per cent will not come back in for a harvest. That is the reinvestment for the next stand and the stand after that, that's the carryover. There are a tremendous number of options available.

MADAM CHAIR: Do you have any sense of the placement of standing timber or the density of it that makes sense, or is that very dependent on the site?

THE WITNESS: That's dependent on the site and I would not presume to be the expert here. From our experience, the way we did this - since you asked the question, and it's an excellent one - I would like to get one thing clear.

One, I do not view myself as an expert, least of all in somebody else's country and least of all in somebody else's backyard. I have found that we didn't have the data in the United States and we've studied this for a decade and we still couldn't give that kind of answer.

So what we did, we got some district rangers on the acres that they had and we went out and we looked at clearcuts and we had silviculturalists, we had pathologists, we had insect people, we had fire people, we had soil scientists, we had the gamit and we went out and we looked at clearcuts and we looked at the specific thing, the amount of dead wood that's left and the size, and we then discussed what we were comfortable with based on what we knew, and when we came to an agreement on that we went to another area and we looked at distribution of wood, and we did this for a week and by the end of the week we had the best management plan I have ever seen.

And I will submit that we will never manage based on technology or data when it comes to making decisions, we will always choose human values. And science and technology will not change the world, people will, and I think we sell ourselves short.

In the last analysis, I don't care how we rationalize these things intellectually, if we don't feel good about it there is something fundamentally wrong with it.

So we have taken our best data and then we've put it to the ultimate test for us, how do we feel about what we've come up with. Then what we've

done is design long-term experiments on the public lands so that some generation can get the answers that we could only really guess at.

This to me is giving a gift or setting up at least so that some generation has the option of actually testing the data that we can only surmise based on all the years that we have looked at it. Does that get at your question?

MADAM CHAIR: Yes, it did. But in the work you were doing on that management plan, you were looking at dead wood as opposed to standing timber that will be part of the succession of --

THE WITNESS: We worked backwards then, what they did, what the rangers then did, we said --

MS. CRONK: Sorry, Madam Chair, we can't hear the witness.

THE WITNESS: Oh, I'm sorry. What we did was then say, this is what we feel comfortable with, now if we project into the future on future stands, what do we have to leave out there and what configuration to accomplish this.

And they came up with some very elaborate, very good plans which they are now testing in fact. What is the economic cost of doing it this the way or that way, what are the options of achieving

these types of leave areas, what are the ecological costs of not doing it, and they have designed a number of experiments which are going to be carried out under normal management with scientific supervision, supervision from the scientists, so that in a hundred years, 150 years somebody has some answers.

We are not capable of deriving those answers today, except the way that I indicated that we have done it, and I am very comfortable with those answers.

MR. LINDGREN: Q. No. 39.

MS. CRONK: Excuse me, Madam Chair. A few moments ago the witness referred, with his hands, to the height of slash in British Columbia and he sort of did give you some evidence about that.

I wonder, for the benefit of other counsel - and I'm sorry to interrupt - and for the assistance of the Board, so that it's clear as we go along, that we have the witness indicate the height to which he was referring. He simply said this high.

THE WITNESS: Oh. Can you hear me better now?

MS. CRONK: Yes, thank you very much.

THE WITNESS: In British Columbia the slash is about like this on clearcuts that have been,

oh must be about four feet off the ground.

MS. CRONK: Thank you.

THE WITNESS: Okay. Some of it's deeper. As I said before, our western hemlock evolved to germinate on dead wood. These are hemlock seedlings that are less than one year old.

They evolved to be able to live without the mycorrhizal component initially because mycorrhizae in dead wood is not very -- does not form readily when it's on a log which is, you know, three feet off the ground because these were big trees. There's a very high mortality rate, which is the cost.

Now, this is what we call a nurse log because--

Q. No. 40.

A. --it is high in moisture, it's high in nutrients and it's spongy, it's an ideal rooting medium.

These hemlock seedlings do not get this large however without being inoculated and the inoculant may come from fungal spores being blown up with the wind, we find some mushrooms fruiting here, which are mycorrhizal with the hemlock, but most of it we find comes from the pooparoonies of the flying squirrel at night, the chickaree in our part of

country - in your part of the country it's the red squirrel - during the day, and the deer mouse at night and also the chipmunk, and I don't know which chipmunks you have here.

But the fact is that the small mammals get up here, and when they leave their little calling cards they break down and they wash in with the water and they inoculate the hemlock roots.

Q. No. 41.

A. These little white spots here are the inoculated root tips of hemlock. Now, our hemlock is a weird tree because it didn't read the botany books. It grows up stumps, it will grow up into an old dead stump, cross over to a log and grow down the full length of the log. And so the wood is very important to it. It grows exceedingly well in mineral soil, but being the understorey component, the climax species of the fire-dependent old growth ecosystem, this is the other way it has evolved to grow.

Q. This is No. 42.

A. Here is a hemlock tree and here is its root, like a hand holding on to its nutrient supply - I pulled the bark off - which is a large snag, a dead portion. It grew, it germinated on the side of this dead tree, you can see here in the bark, and its

roots grew up and are now extracting nutrients from that tree.

Q. This is No. 42. Madam Chair, the previously photograph is a new photograph and we'll undertake to provide copies.

A. Oh, I'm sorry. This is my normal lecture.

Q. That's okay.

MS. BLASTORAH: Perhaps we could refer to that as 41A just for the purposes of the record.

MR. LINDGREN: Thank you.

Q. We are now looking at No. 42.

A. This is a Szitcus spruce tree which germinated on a fallen log when the log was about up to here, this is where the butt swell starts. The log has since disappeared and the tree is using up the nutrients, here are its roots. Now, these roots originally grew underneath the bark and they grew out the bottom of the bark as the log was decomposing. When a log rots out completely, it leaves the tree on stilts.

Q. No. 43.

A. And a lot of the Olympic Peninsula is like this and we found the same thing in higher elevation in the Swiss Alps and the German Alps along

the border where the trees still had enough logs to grow on.

In Alaska and in the muskeg area, these fallen trees are very important to the germination and growth of the forest for another reason, there the seedlings perch on top of the fallen trees to keep out of the water, and then once they are established, their roots can grow down. So these large logs form more than one set of scenarios in the system.

Q. No. 44.

A. Now, as I said before, we make a lot of mistakes and we have not had our share of humility science and this was one of the more dramatic lessons to me.

We discovered a few years ago that inside the mycorrhizal fungal material were nitrogen-fixing bacteria. No one had ever seen that before. So we did what good scientists do, we thought in intellectual isolation and we successfully killed the whole system for one year, because we needed we thought a culture in which we could separate the fungus from the bacterium, and we did that and we sterilized it and we killed it successfully.

Finally we ended up with a mistake, we got a contaminated petri dish and this was the result.

These little fuzzy things are the fungus and this is the bacteria colony and, like the termite, the whole system works beautifully. This fixes a tremendous amount of nitrogen. And we tested this over and over with acetyline reduction, which is a technique for getting at nitrogen-fixation.

This is growing on nitrogen-free medium, augered medium. Now, when we discovered this we also realized that the small mammals we had studied for years fed on the fruiting bodies of the mycorrhizal fungi, so a logical question: Was do small mammals send through their system nitrogen-fixing bacteria and noculate the soil with the spores.

I think I found the only benevolent use of terror in the world. We wanted to use flying squirrels but we didn't want to kill them, so we trapped them alive and we put them in sterile white cloth sacks and I terrorized them for 30 seconds and we always had calling cards.

And we take these little calling cards back to the lab and we inoculated the petri dishes and this is what we got. This is a nitrogen-fixing bacterium. Now, if you'll notice it is long ones and straight ones and short ones and fat ones and curved ones and skinny ones. Obviously in our thinking that

was contaminated, so we threw it out, and we threw it out trial, after trial, after trial for six months.

And then a friend of ours, a Dr. Telac from New Delhi, India, who is a world class microbiologist came to the States to study mycorrhizae because they are replacing rhizobium in the nodules on soya beans with a bacterium called azosperium and they're doubling and tripling their crops under experimental conditions.

So in frustration the C.Y. Li who is the Chinese micobiologist working with us said: Telac, do you know what this? He said: Oh yes, that's azosperium. It's highly polymorphic, that means it comes in many shapes. And we had a pure culture the first time around, but with our straight line mentality and our isolated thinking we threw this out.

Now, this is from the flying squirrel. We also got it from a number of other animals. One -- then we tested the deer mouse--

Q. This is No. 46.

A. --which we in the States had poisoned at the cost of millions of dollars over the years because they ate tree seeds in areas of natural regeneration. But if you'll notice these little green areas, those are resting spores called endospores,

inside spores. This bacterium is a nitrogen-fixer which is a textbook classic called Clostridium butyricum. In every textbook that deals with nitrogen-fixation that I've seen, this organism is mentioned.

You see, we never asked what the deer mouse did that might be beneficial to the system and this is what I said before, in science we must be very careful and have a great deal of humility because all we can ever interpret is the appearance and the appearance was the deer mouse was detrimental to reforestation, to planting trees.

In fact the surface of our clearcuts in the summer, particularly if they had been burned, can reach 160 degrees fahrenheit and these little spores can withstand those temperatures, so the deer mouse serves a very important function.

Q. This is No. 47.

A. Now, inside the animals is a pouch called the cecum, which this will have to represent. The mouth is up here and it goes from the mouth to the stomach, to the small intestine, and at the juncture with the large intestine which becomes the colon and the rectum is a pouch called the cecum.

And we discovered when we were working

with the food habits of the animals that in the flying squirrel there were yeast propagules - now, yeast is another kind of fungus - and in the deer mouse there was so much yeast we couldn't count it, and this is a drop diluted -- this is a hundred times dilution.

What we discovered was there was more yeast going through the small mammals than we could find in a given area in the ground of a similar size. So we wondered what this was all about, and we found that the nitrogen-fixing bacterium, azosperium, is fed by the extract of another fungus, that's why in the contaminated petri dish the fungus was feeding the bacteria and the bacteria was producing nitrogen which kept the fungus going.

The yeast inside the small mammals lives, it does not die in going through the cecum, so while it is circulating in the cecum it's producing nitrogen which keeps the nitrogen-fixing bacteria, it feeds the bacteria, the bacteria in turn keeps the mycorrhizal spores going.

So the way this works is, the animal at the front end is a little pharmacy, it eats the material, it stores it in the cecum, it concentrates it, it forms it in fecal pellets and it goes out through the dispensary and out into the forest soil.

Working with deer mice we found that they can hold this material inside their bodies for up to one month after their last meal, and a colleague of ours at Wake Forest University in Winston, Salem North Carolina has been studying the endangered fox squirrel that lives in long-leaf pine plantations in forests in the south, and he copied what we had done and found that the fox squirrel can maintain within itself this inoculum for up to 84 days after its last meal.

Now, that's important, because when we study the deer mice I did something I promised myself I would never do, I spent a winter counting animal poops, and I wouldn't do that because that's what the big game biologists do and I never really wanted to be a biologist. This was much more sophisticated, however.

We found that deer mice give off an average of 66 pellets in 24 hours. I mean, that was really exciting stuff. And we found that the red-backed vole gives off about 300 pellets in 12 hours, in fact the red-backed vole on the coast in Washington - the same species you have here but in the State of Washington - is so dependent on the fungi that they eat more than their weight every 12 hours or they starve to death, of this fungus. It also gives them their water supply.

Now, the reason the pellets are important because it takes 1 in 10,000 mycorrhizal spores to inoculate one root tip of one tree and when the deer mice have been eating just the fruiting bodies they have between 800 -- 500 and 800,000 spores in each pellett, plus nitrogen-fixing bacteria, plus yeast.

The red-backed vole has about 300,000 spores and one deer, one little round deer pellet has a about 2-million. So they are very potent inocula in the forest soil.

Q. No. 49.

A. What we did then was take the animal droppings from our lab experiments and we got some in the field and we macerated them in distilled water and we inoculated sterilely-grown seedlings, we used Douglas-fir, but it has since been done on large-pole pine.

We put inoculum in here, the seedlings -- there were no nutrients in the tube and what we put in was a slurry of mycorrhizal spores, yeast and the nitrogen-fixing bacteria. Now, the thing that is important with this is we used three genre of fungi, two of which no one had ever been able to germinate in a laboratory.

When they went through the animal's

intestinal tract all three germinated, and so we are beginning to question whether or not going through a GI tract of an animal may be necessary to what's called stratify the spore.

Some tree seeds need to be frozen before they will germinate, they have to go through a cycle. Do these have to go through heat? One of our colleagues heated some of them to a critical temperature very fast and took them away, and lo and behold, it also germinated.

Now, the animal temperature is fairly high internally and if they can hold them that long, is there something in the animal's gut that's necessary to germinate some of these mycorrhizal spores

The other question we asked is: Are there germination inhibitors in the spore coats, that the digestive juices of the animals leach out. We don't know. But these are some of the questions that we are only beginning to understand that need to be asked.

Anyway, at the end of six months of growing in the greenhouse we pulled these out and we do what we call reading the roots. Under a microscope we look at the roots, we test them for nitrogen-fixation and we found that all of the mycorrhizal fungi had

germinated, all three genre, there were high amounts of nitrogen-fixation in every test tube and they all had yeast and the yeast, in order to nourish the bacteria has to be alive.

So we tested this system with yeast from St. Lawrence Island, Alaska across the entire United States including the desert area with rabbits and hares to the east coast and found across the entire U.S. there is a range of animals that inoculate the soil with nitrogen-fixing bacteria.

So there is -- through their droppings there is a definite feedback loop, and it's these feedback loops that are so critical to maintaining the health of the system. We call them positive feedback loops, but if you start a negative cycle in a forest you still have a positive feedback loop that produces a negative result, and it's these feedback loops that we have to be very careful with because we are only beginning to understand how some of them might function.

Q. No. 50.

A. We clearcut and burn. Now, there are several things I would like you to be aware of on this slide. Remember I said this morning that we are making the wood -- or with the slide presentation, the large

woody material a finite resource. Take a look at this slope that was old growth. It was logged once, it came in with natural regeneration, and this is the logging of the first rotation.

What nature gave us is not a rotation, that is a forest. The first rotation is the first harvest after the clearcutting. Look how little large wood is left. Look also how few large stumps are left, and look at how little of this wood is going along the contours. There is one big log going along the contour, these others are going up and down.

When wood goes up and down the contour, it cannot store water because gravity pulls the water down to the lower end and it drips out the bottom. It can also not keep soil from ravelling downslope, like this one can, because there's nothing to hold the soil in place.

Now, we have also found that small mammals using this as travel aids much more readily than they use logs up and down the slope. The surface of this -- this surface temperature in the summer would reach 160 degrees fahrenheit. The nitrogen-fixing bacterium that was in the deer mouse can withstand temperatures of 170 degrees or 80 degrees celsius, so if the deer mouse, which is not killed by these fires,

they are protected in their burrows, the fires are not hot enough to suck the oxygen out, when they come out, if they had fed on a mycorrhizal fruiting body within a month and if they've only nipped on it, if they have just taken a few bites they still have up to 25,000 spores per pellet which means they can still inoculate the site.

When they come out and start moving around they are reinoculating these areas and the highest inoculum tends to be where the animals are most prevalent, and that is along the wood.

In the early days in the United States in the northwest we used to burn this type of material, pile it and burn it to get rid of rodent habitat because they ate seeds; today we are arranging the large woody material to manage for these rodent populations so they can begin to form the cyclic feedback loop of reinoculating the soil that we earlier took away.

Q. 51.

A. This is a Class 5 log. You will notice that it's completely buried and it's all heart wood and it has hemlock growing out of it. Embodied in this log, as long as it is in tact, the same as these two which are buried--

Q. No. 52.

A. --is roughly 50 to a hundred years of nutrient cycling that is still in place and free, provided we do not disrupt the continuity of that wood by dragging other logs over it or with caterpillars, or driving caterpillar tractors over it.

We are learning to stick more and more closely to defined skid trails if tractor logging is done to protect as much as we can of the already inherent nitrogen nutrient cycling that is in place.

Q. No. 53.

A. The fungi, the truffles attract the animals as they mature. This is an immature fruiting body and you will notice it's white, it has almost no odour.

As the truffles mature they get darker as the numbers of the maturing spores increase and they give off odours which are specific to the species, and we can detect the odours of many of them.

In Europe they train dogs and sows to sniff them out. In the early days they put muzzles on them--

Q. We're now looking at No. 57.

A. --and today they just harness the pigs like this, and they use sows not boars, the sow is

the female and the boar is the male.

These animals sniff the truffles out and they then dig them out and the famous Italian truffle today costs anywhere from $600 to $800 a pound because a change after World War II in forest management has that very important commercial crop on a drastic decline.

They use sows. I make a point of that, because the chemical odour, the feramone as we call it, that is given off by the truffle is identical to a boar that's ready to reproduce, that's physiologically ready to reproduce. So this association has been around for a very long time.

Q. 58.

A. In fact we are sure that when the continental drift took place since the mycorrhizal component goes back roughly 400-million years, that plants and animals, forests and their animal components evolved and moved, migrated together, because this is world wide and there are many similar species in Europe and the United States that share the same function, like red-backed voles in Europe, the red-backed voles in the United States, et cetera.

This is one the reasons that we are looking at this very carefully and trying to figure

out: How do forests migrate, and if we have to help them in management in the face of global warming, how do we do that?

In our part of the country the little chickaree, which your counterpart is the red squirrel, feeds on truffles.

Q. 59.

A. We find their pits and what they don't eat they tell us where to dig, we can glean for study.

Q. 60. This is No. 61.

A. We have found that organisms like shrews feed on the fungi.

Q. 62.

A. And the red-backed vole. This particular red-backed vole is confined to western Oregon and northwestern California.

On the coast 98 per cent of its diet are these fungal fruiting bodies that it's eating right here. When it moves inland to the Cascade Mountains, which are our north and south mountains, the diet drops to 85 per cent truffles and the rest is made up primarily with lichens.

If you go across the Columbia River into Washington, there's another species called the - this

is the western red-backed vole - the southern red-backed vole which goes from the Pacific Ocean to the Atlantic Ocean, goes across Canada, down the Rocky Mountains, down the Appalachians.

Its diet in the Olympic Peninsula is virtually a hundred per cent truffles. When you get to the Washington Cascades it's about 80 per cent, when you get to the Rockies, it's about 50 per cent because the Rockies are much more open, when you get to Carolina it's almost zero, but when you come up into the boreal forest again - and we looked at organisms from Ontario - it's virtually a hundred per cent.

We also had a paper which was just published this year in the Canadian Journal of Zoology looking at the tooth structure of these organisms and we found that as their diet shifted across North America the structure of their teeth shifted also. So they are adapted to the diet.

We found the same thing with the deer mouse across the country. The deer mouse fed very heavily on the mycorrhizal fungi in the Pacific northwestern forests, zero on the east coast, but when it comes back up through the boreal forest, in some areas it was virtually a hundred per cent again.

Now, this animal is dominant in the old

growth and there are studies in the northeastern part of the United States that show that clearcut logging, the same as in the west, eliminate this animal because in the conifer forests it is dependent very heavily on the mycorrhizal fungus for its diet. It in turn inoculates the soil.

We on the other hand have another small animal called a creeping vole which in our old growth forests can feed on these fungi belowground for centuries, for hundreds of generations. They are subordinate to the red-backed vole.

Now, most of the scientific literature states that the deer mouse is the common small mammal in the old growth forests. We found that it's not true, and it's not true because there are assumptions in the trapping of these animals that are inherently false.

One is that all of the animals like the same bait, they like it equally; well, deer mouse love peanut butter, but not every other rodent loves peanut butter. Deer mice are very exploratory, the red-backed voles that we worked with are not, they are more exploratory on the east coast. The animals do not use the surface of the ground equally.

So what we found was the red-backed vole

is the dominant animal but all the literature says the deer mouse is, and we demonstrated that because we do not use bait for red-backed voles, we trap them without bait by putting the traps in their runways, and you can use pitfall traps.

The deer mouse catch dropped 80 per cent and the red-back vole catch rose, so we know that the red-backed vole has been the dominant animal in the west.

During the 50s and 60s we asked the question: Why, when the old growth forest is removed, does this little animal absolutely explode in numbers and the red-backed vole die out of the clearcuts? Why is there a shift in the population?

But nobody looked at food habits until we started studying them a decade ago, and we found something very interesting that answered the question. This little animal can feed on the fungal fruiting bodies exclusively for generations, as does the red-backed vole, but the red-backed vole is the dominant animal and this one is subordinate.

As soon as the forest canopy is removed and the grasses and forbes come in, this little animal shifts its diet completely to grasses, for example, and its numbers explode and the red-backed vole dies out

within a year because when trees are cut and the roots die the fungus stops fruiting and the vole simply starves to death. As the forest comes back in, their population shifts again. So the dynamics of this are a continual cycle, there is nothing static, simple or easy about its.

Q. No. 64.

A. Chipmunks and deer mice are very important inoculum because they go to the established forest where they feed on the spores and their fruiting bodies and then they go out and visit the clearcuts and they inoculate the soil as they go.

I don't know about your clearcuts, but ours, we very often find that the trees do their best right around the edge and conventional wisdom has said that's the distance that the seeds fall, that is where the wind blows them, and that is shade.

That may all be part of it, but I went back to the animal damaged data that was collected at the cost of millions of dollars and reinterpreted it and I asked the question: If these little animals have in their droppings the ability to inoculate soil,what is their home range, how far out into clearcuts do they go?

And so reinterpreting the damaged data we

then looked at soil and found out that the ring that does the best around the edge of established trees is the distance these little mammals visit into the clearcut from the edge.

So all we did was reinterpret the data that was looked at very narrowly and we looked at it broader and found that these little animals do in fact go out this distance, they do eat some seeds, they also inoculate the soil.

There was a study done on the east coast which to me was seminal. When we first came out with our experiment nobody seemed to pay much attention except for one pair of researchers dealing with trying to reclaim mine spoils, and they were doing the same thing, they were trapping all the rodents, poisoning them because they saw them eating vegetation they were trying to get established.

After they read the paper that we had written, they did some experiments and found where they excluded the animal, so they couldn't get in, the vegetation died; where the animals and vegetation were together, it survived because they found those animals were also moving around the mycorrhizal inoculant that the mining spoils needed in order to be able to survive.

There is an animal that you have in Canada called a heather vole, we have it in the States too, and at high elevation they are the little organisms on mudflows from glaciers and on the moving creeping timber line allow the trees to become established in meadows. They feed in the winter on the mycorrhizal component and they have tremendous toilets, where they go potty just in one area, and that inoculates the soil to such an extent that the timber line can creep up to those areas as the seeds get there. And we've documented this on mudflows on Mount Ranier. Those small organisms live at the edge of the habitats, they are very docile animals, they do not stand competition, but they are responsible in many areas for the creeping timber line and the recolonization of severely disturbed sites.

Q. No. 65.

A. The pica also is very important in high elevation around talus or rock slides. We have another organism called a mantled brown squirrel--

Q. 66.

A. --which feeds on the truffles in the pine area, the ponderosa and large-pole pine and is very instrumental in the pine area.

Q. 67.

A. And the northern flying squirrel. The northern flying squirrel is one of our more important fungus feeders. I will use this as an example of a positive feedback loop and then I will go on.

You have the northern flying squirrel here and studies have been done at Fairbanks Alaska where the flying squirrel is probably the critical fungus feeder in that part of the country. It lives in mistletoe brooms, in the big witches' broom on the trees that are infected with mistletoe. It feeds on the fungi and the fungi grow only a certain distance out from the dead wood. It's much more confined to the wood than it is further south.

Now, the flying squirrel nests in the tree tops and it reproduces in the tree tops, but it comes down, it glides down at night - they can't fly, they can only glide on membranes - they come down to the forest floor at night and they sniff out the fruiting bodies of the truffles. They eat the truffle. If in sniffing out a fruiting body and disturbing the soil they uncover a root tip which has not been inoculated and they leave a little pooparoony there, the yeast can stimulate the germination of the mycorrhizal spores, the nitrogen-fixing bacteria kicks

in and produced nitrogen, this whole little thing then inoculates the root tip and it might be of the squirrel's own tree.

So in this sense the squirrel is keeping the forest that it depends on healthy in a positive feedback loop and rodents are doing this 24 hours a day; above ground from the tree tops when they defecate, belowground and on the surface.

Now, let's assume that the root tip that it has dug out is already inoculated, it has this mantle around it, and it leaves a calling card but that calling card is the same species of fungus that that root tip already is inoculated with, then the non-reproductive part of the fungus called the thallus, they fuse, and that is one of the ways genetic material is exchanged throughout the forest.

And this is important because the rodents move all around the forest, they have what we call a home range, an area of normal habitat use. There may be -- some of them -- some of ours, I'm used to acres, but an acre, two acres, a hectare or more, and they pick up the fungus here and they drop it over there with their droppings, so they are moving the genetic material around the forest. That is one of the ways that it gets moved.

We also couldn't figure out for a long time - I studied bob cat and cougar - mountain lion food habits, I found flying squirrels in their droppings and coyotes. We finally figures out they're vulnerable when they're on the ground feeding.

The other thing we've looked at was that the data from some of the wildlife surveys showed the flying squirrel was very closely tied to large amounts of large dead wood. So when we put the pieces together and we looked at how the fungus fruits, we then looked at the spotted owl which has caused -- that issue has caused all the fervor in the northwest, a very interesting feedback loop showed up.

The spotted owl lives in old growth trees, our old growth forests are high in amounts of dead wood, the dead wood is where the fungus fruits most prolifically and that's where the moisture is.

The flying squirrel lives in the tree tops, comes down and feeds on the fungus which is dependent on the wood and the flying squirrel is the main prey of the spotted owl.

So if we remove, as industry has suggested, if we allow them to highgrade the forest floor, which is disturbing the cycle, the feedback loop of the old growth, we remove the wood that has an

impact on the fungus, has an impact on the squirrel, we lose the owl. And this shows that then the whole system begins to reorganize but it will be different, we have lost the integrity of the old growth.

So if we are to set old growth aside as a system for future reference for its potential to learn from, we must maintain its integrity because we do not know, with a very simple act of -- salvage is the most dangerous thing we do across the board in my opinion, because we say that wood out there has no value unless it's at the mill and that's what industry has asked over the years: Can't we just salvage this dead wood in the old growth? But then you lose the integrity of the system because now you start a negative positive feedback loop, one that has negative impacts, and those are the things that we need to become cognizant of.

Q. No. 68.

A. Deer - this happens to be a mule deer - elk and bear move the mycorrhizal fungus vast miles. One elk can travel up to 50 miles a day easily.

I asked a friend of mine who was studying elk to collect droppings for me on a monthly basis, and we found that elk and deer feed on the mycorrhizae whenever and wherever they are available.

Now, a couple of things about the flying

squirrel before I bring this part to a close. The flying squirrel in northern Oregon feeds on the truffles spring, summer and fall but they are unavailable in the winter, the same is true in Alaska, so the squirrels shift their diets to lichens in the tree top and these are old growth trees.

The squirrels do far better in an old growth system than they do in a young growth system, that is their preferred habitat, that doesn't mean they don't live in second growth forests or young growth forests.

In southern Oregon -- southwestern Oregon the squirrels feed on the fungus year round because it is not unavailable, it is available all the time.

So again I would caution about making blanket statements about any areas, other than saying the principles are a common denominator, but there is variability throughout the system. We simply cannot make blanket statements. These are what we call symbiotic pills, these are the droppings of the flying squirrel.

Q. This is No. 69.

A. And it's these little components that can inoculate seedlings. Consider that if a deer mouse gives off 66 pellets a night with the total compliment

that's necessary, consider also that there is enough nutrients in a pellet to the maintain the health of the spores in the bacteria, and consider also that these pellets contain something, a kind of anti-freeze - we don't know what it is - that prevents the nitrogen-fixing bacteria from rupturing during freezing.

Microbiologists dried --they freeze-dry bacteria to save them for long periods of time because if they freeze them wet, that is normally, when they thawed the,membrane ruptures and bacteria is killed.

Inside the droppings we found is something that prevents them from freezing, so these can be over wintered and inoculate the soil in the spring.

So when you have considered all of this and that this is constantly being put into the system and then you have the deer mouse, which if you have five deer mice at 66 pellets a night, that's roughly 1,000 pellets in five nights that have enough inoculum that if one was dropped by a root tip of -- it's 990 some trees, you could inoculate those root tips with life.

When you have the rodents performing this function throughout the forest over and over and over

and you simplified the habitat above ground which automatically simplifies it and the processes belowground, we can have a dramatic impact on how these forests function.

Because we must remember, half of the forest is belowground but we only manage what we see above ground. We cannot have an impact above the surface without having a simultaneous and similar impact in magnitude belowground.

Q. Mr. Maser, perhaps if we could just pause there.

MR. LINDGREN: Madam Chair, we have approximately eight slides left. We could finish them now or put it over until tomorrow morning.

MADAM CHAIR: Why don't we stop now and we will pick it up in the morning, Mr. Maser.

THE WITNESS: Okay. It's my pleasure.

MADAM CHAIR: Thank you.

MR. LINDGREN: And, Madam Chair, I can advise that if we are not finished by noon, we will be finished shortly thereafter, so I would suggest that Mr. Hanna be contacted and be advised that he is likely to be called tomorrow afternoon.

MADAM CHAIR: Thank you, Mr. Lindgren.

And we will be back tomorrow morning at

nine o'clock.

MR. LINDGREN: Thank you.

MADAM CHAIR: Thank you.

---Whereupon the hearing adjourned at 4:00 p.m., to be reconvened on Tuesday, January 29th, 1991 commencing at 9:00 a.m.

[illegible] in the [illegible] above ground which [illegible] the processes [illegible] have a dramatic impact on how these [illegible]

Because we must [illegible] of the [illegible] we cannot have an impact above the surface without having a significance and [illegible]

Q. Mr. Baker, perhaps if we could just pause there.

MR. LINDGREN: Madam Chair, we have approximately eight minutes left. We could finish them now or put it over until tomorrow morning.

MADAM CHAIR: Why don't we stop now and we will pick it up in the morning, Mr. Baker.

THE WITNESS: Okay. It's my pleasure.

MADAM CHAIR: Thank you.

MR. LINDGREN: And, Madam Chair, I was advised that if we are not finished by noon, we will be finishing shortly thereafter, so I would suggest that Mr. [illegible] be contacted and be advised that he is likely to be called tomorrow afternoon.

MADAM CHAIR: Thank you, Mr. Lindgren.

Hearing will be [illegible] tomorrow morning at